A Survey and Analysis of the Fish Fauna

of the

Barataria Preserve of Jean Lafitte National Park

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Abstract

A survey of the fishes the Barataria Preserve of Jean Lafitte National Park was conducted in order to document its fish fauna, to identify patterns in the distribution and abundance of fish communities, and to determine if the patterns are related to variation in environmental parameters. The fauna is interesting because it consists of a mixture of freshwater and euryhaline marine species. To reduce overall sampling bias that is known to be associated with fish sampling methods, three different methods were used, seining, electrofishing, and gillnetting with both standard gillnets and trammel nets. Water chemistry (pH, dissolved oxygen, oxidation-reduction potential, conductivity and salinity), temperature, and clarity were measured at or near each sampling station. The latitude and longitude of each sampling station was recorded. Patterns of co-occurrence of fish species were determined using principal components analysis. The relationship between environmental parameters and principal components was analyzed by examining their correlations. Fifty-seven species comprising 26 families of fishes were found, including 15 species that had not been recorded previously. Four different patterns of species distribution were identified. Dissolved oxygen content, pH, and water clarity were significantly correlated with patterns of species distributions. No threatened or endangered species were found in the Preserve. The fish communities of the Preserve appear to be stable and no special actions seem necessary to maintain them in their current state. Hydrological modifications within the Barataria Bay estuary will potentially impact the fish fauna of the Preserve through the introduction of exotic species.

Introduction

The Barataria Preserve of Jean Lafitte National Historical Park and Preserve is a 20,000-acre wetland complex located approximately 15 miles south of New Orleans, Louisiana (figure 1 and figure 2). The Preserve has within its boundaries a complex set of aquatic habitats including man-made canals, natural bayous, ponds, and marshes. It is bordered by Lake Catouache and Lake Salvador on the west. These lakes are in the northernmost reaches of the Barataria Bay estuary, one of the most productive aquatic systems in North America. The waters of the preserve are predominantly fresh, but the southern end of the Preserve borders the brackish marsh of Barataria Bay. The fish fauna of freshwater systems in south Louisiana is relatively small because of low oxygen concentrations associated with very warm slow moving water. However, where freshwater systems grade into low salinity coastal marshes, as found in the Preserve, the typical freshwater fauna is enriched by species that live within the brackish marshes as well as seasonal migrants and life stages of marine species from coastal waters of the Gulf of Mexico. The fish fauna of such systems is also dynamic due to the seasonal changes in salinity regimes of near-shore waters, temperature dependent tolerance of freshwater in marine species, and species-specific migration into freshwater.

This study documents and analyzes the fish fauna of the Barataria preserve that was found during a series of samples taken from park waters from September 2003 to March 2005. Previous work within and near the Preserve found a total fish fauna of 50 species representing 24 fish families. Table 1 compiles fish species taken from waters of the Preserve in collections made by the US Park Service in 1984, the Louisiana Department of Wildlife and Fisheries in 1981 and 1984, Margaret Seale of Tulane University in 1998 and 1999 (Seale 1999) and the US Geological Survey in 1999 (Swarzenski et al. 2004). This study was begun because this list was believed to be incomplete due to a variety of factors including a limited number of collecting methods, a limited time frame of each of the prior studies, and a limited number of habitat types sampled. Previous studies also provided little information of species distributions within the Preserve or ecological descriptions of the habitats where each species was found.

Such data are essential to an effective management program or a program designed to monitor faunal change.

This study was designed to provide a list of species occurring within the boundaries of the Preserve and their distributions, to provide descriptions of habitat types where species with limited distributions occur, and to identify environmental parameters that may influence species distributions.

Methods

It is well known that fish sampling methods are biased (Cashner et al 1994). Each method underestimates some components of the fish fauna and overestimates others. To reduce overall sampling bias, three different sampling methods were used throughout this study, seining, electrofishing and gillnetting using both a standard gillnet and a trammel net. The original plan was to sample every other month throughout the course of one year, conducting 4 seine samples, 4 electrofishing samples, and 2 gillnet and trammel net samples. The entire sampling year would thus produce 72 samples: 24 seine and electrofishing samples and 12 gillnet and trammel net samples. However, the vagaries of weather and coordination schedules of student assistants resulted in a longer sampling schedule, spanning 17 months. In addition, practical issues of sampling specific habitat types resulted in reduced opportunities for seining and a need for more electrofishing effort. In total, 102 stations were sampled. Figure 3 shows the location of each station within the preserve. Thirty-six stations were sampled by electrofishing (figure 4), 23 by seining (figure 5), 22 by gillnet (figure 6) and 20 by trammel net (figure 7). One station was sampled using a dip net only.

The latitude and longitude of each sampling station was recorded using a hand-held GPS unit (Garmin 48 using WGS84 coordinates.). Coordinates of start and stop points of electrofishing stations were recorded. The coordinates of the ends of the gillnet and trammel net were recorded for each station. The coordinates of the landing point of seine samples were recorded.

Electrofishing samples consisted of a minimum of 500 seconds of current applied to the water. Current was applied to the water intermittently using a foot-activated switch. The electrofishing control box was equipped with a timer that reported the number of seconds the foot-activated switch was depressed. Generally, 500 seconds of electrofishing required a real-time effort of 20 minutes or more. Electrofishing samples were usually conducted along the shoreline of a water body. In some circumstances the water body was too shallow to approach the shoreline by boat. In those cases electrofishing was conducted as near the shoreline as practical.

Seine samples were taken with a net that measured 60 feet by 8 feet with a 1/4 inch mesh. Most seine samples were taken with the use of a boat to pull the net from the shoreline. The net was equipped with 100-foot bridle ropes on each end. The net could thus be pulled up to 100 feet from the shoreline and the boat could then return to shore leaving the net deployed 100 feet from short from shore. The bridle ropes were then used to land the net. Each seine sample operation was consisted of a minimum of two net deployments and landings. Occasionally the net became snagged or rolled during landing. When the seine sample was judged to be ineffective, because of snagging or rolling of the net, the sample operation was repeated until a minimum of two effective seine samples were taken.

The gillnet used measured 500 feet by 8 feet and had a mesh of 3 inches. The trammel net used measured 200 feet by 8 feet and had an inner mesh of 12 inches and two outer meshes of 3 inches. Gillnets and trammel nets were deployed away from shore where possible or along the edge of grass beds parallel with the shore in more restrictive water bodies. They were usually deployed near each other and were deployed for a minimum of two hours and commonly deployed for four hours.

Where practical, samples were sorted and the fish identified at the sampling station. When this was possible, all specimens not required as voucher specimens were returned to the water at the site. Small specimens that could not be identified without magnification, and all potential voucher specimens were preserved in 10% formalin at the sample site. Preserved specimens were returned to the Marine Biology Laboratory at Nicholls State University where they were identified. A collection of photographs of representative individuals of all species sampled was made. When possible, live specimens were photographed in the field. Otherwise photographs were made of preserved specimens.

Voucher specimens of all species taken were prepared, with the exception of a few species where only very large individuals were sampled. Voucher specimens were deposited at the Tulane University Museum of Natural History.

Water chemistry, temperature, and clarity were measured at or near sampling stations. Water clarity was measured with a Secchi disk. When water clarity was high enough for the Secchi disk to be seen sitting on the bottom, the depth of the water was recorded as the Secchi depth. Water chemistry was

quantified with a Hydrolab Sonde unit. The unit measured temperature, pH, dissolved oxygen, oxidation-reduction potential, conductivity and salinity each measure was recorded at every site but two. Those sample sites were located within the marsh and had to be accessed on foot, which made transport of the Hydrolab equipment impractical.

A goal of this study was to identify habitat specific distributions of communities of species that live in the Preserve. Sample sites that had groups of species in common were identified using principal components analysis (PCA). PCA identifies axes of variation (patterns) in species composition among sample sites. In PCA, sample sites with large differences in species composition are separated along the axes identified. Thus, sample sites with similar and distinctive patterns of species composition were identified. To determine if the PCA axes of species composition were associated with environmental measures, the correlation between each axis and environmental measures was examined. High correlations between PCA axes and environmental measures suggest what environmental measures are most important in determining variation in species composition.

Results

A total of 8208 fish, comprising 57 species representing 26 families were sampled and identified in this study. Table 2 lists the fish species sampled, the total number of individuals sampled, and the number of sites where each species was found. The traditional habitat preference classification is also given in the table. Among the 57 species found in this study were 15 species that had not previously been reported from the Preserve.

Table 3 details the number of species collected by each method, the number of individuals sampled, and the number of sites where each species was found using each method. Seining yielded 4654 individuals and a total of 46 species. Electrofishing yielded 3369 individuals and a total of 38 species. Gillnetting yielded 108 individuals of 16 species. Trammel netting yielded only 25 individuals of five species. One species, *Archosargus probatocephalus* (sheepshead), was collected only in gillnets and trammel nets. No other species was unique to these two methods. The trammel net was the most effective method for capturing *Cyprinus carpio* (carp). Eight species were collected exclusively by electrofishing: *Ameiurus natalis* (yellow bullhead), *Ameiurus nebulosus* (brown bullhead), *undulus pulvereus* (bayou killifish), *Lepomis cyanellus* (green sunfish), *Aplodinotus grunniens* (freshwater drum), *Anguilla rostrata* (American eel), *Amia calva* (bowfin), and *Erimyzon sucetta* (lake chubsucker). Most of these species were collected at relatively few sites. Fourteen species were collected only by seining: *Pylodictis olivaris* (flathead catfish), *Labidesthes sicculus* (brook silverside), *Fundulus grandis* (Gulf killifish), *Morone mississippiensis* (yellow bass), *Gobionellus oceanicus* (highfin goby), *Citharichthys spilopterus* (bay whiff), *Trinectes maculatus* (hogchoker), *Dasyatis sabina* (Atlantic stingray), *Dorosoma petenense* (threadfin shad), *Membras martinica* (rough silverside), *Cynoscion arenarius* (sand seatrout), *Gobionellus boleosoma* (darter goby), *Gobiosoma bosc* (naked goby), and *Syngnathus scovelli* (Gulf pipefish). Six of these species are demersal, making them unlikely to be seen when stunned during electrofishing. The Gulf pipefish is also unlikely to be caught by electrofishing because they are usually in thick vegetation and do not rise to the surface when stunned.

Analysis of Fish Distributions

A principal components analysis of fish distributions among sample sites was conducted. Only electrofishing and seine samples were used in this analysis because these methods were the most effective techniques for sampling the entire fish community at any site. Only species that were found at more than one site were included in this analysis. The analysis included 45 species collected at 59 sites. The first principal component (PC1) accounted for 11.3 % of the variation in species composition among sites. The second principal component (PC2) accounted for an additional 9.7% . The third principal component (PC3) accounted for an additional 7.3%. Thus, 28.3% of the variation was accounted for by the first three principal components.

A plot of the distribution of sample sites on the first two principal components is shown in figure 8. The distribution of sites in this plot has a roughly triangular pattern. Thus, three extremes in species composition among sample sites are clear. I've labeled these group 1, group 2, and group 3. There are those communities that have high positive scores on PC1 (group 1), and two separate extremes with high negative scores on PC1. Among those with high negative scores on PC1 there are sites with high positive scores on PC2 (group 2) and sites with high negative scores on PC2 (group 3). The different placement of sites on the plot is due to differences in species composition of the samples taken at those sites. The species found commonly at group 1 sites were *Dasyatis sabina* (Atlantic stingray), *Elops saurus* (ladyfish), *Anchoa mitchilli* (bay anchovy), *Brevoortia patronus* (Gulf menhaden*), Ictalurus furcatus* (blue catfish), *Ictalurus punctatus* (channel catfish), *Membras martinica* (rough silverside), *Strongylura marina* (Atlantic needlefish*), Syngnathus scovelli* (Gulf pipefish), *Micropogonias undulatus* (Atlantic croaker), *Gobionellus shufeldti* (freshwater goby), *Gobiosoma bosc* (naked goby), and *Paralichthys lethostigma* (southern flounder). The common group 1 species are, with the exception of the two catfish, all euryhaline marine species. Figure 10 shows the geographic location of group 1 sample sites. Those sites are either on the shores of Lake Salvador, Lake Catouache or at sites that freely connect with the lake.

The common species at the group 2 sites were *Lepisosteus oculatus* (spotted gar), *Anguilla rostrata* (American eel), *Menidia beryllina* (inland silverside), *Lepomis gulosus* (warmouth sunfish), *Lepomis macrochirus* (bluegill sunfish*), Lepomis microlophus* (redear sunfish), *Lepomis miniatus* (spotted sunfish), and *Micropterus salmoides* (largemouth bass). Most of these species are in the sunfish family (Centrarchidae). The sunfish species found in the Preserve are among the most common species sampled in freshwater in south Louisiana. The only one of these species that is commonly found in coastal waters is the highly euryhaline inland silverside. American eels spawn in the Atlantic Ocean and the juveniles live in freshwater. The eels sampled included both adults and juveniles. It is likely that American eels are regular long-term residents of the Preserve. Figure 11 shows the location of group 2 sites. Most are found in the interior of the Preserve, but sites that have characteristic species of this group are also found along the lakeshore.

The common species at the group 3 sites were *Fundulus chrysotus* (golden topminnow), *Gambusia affinis* (western mosquitofish), *Heterandria formosa* (least killifish), *Poecilia latipinna* (sailfin molly), *Lepomis symmetricus* (bantam sunfish), and *Elassoma zonatum* (banded pigmy sunfish*)*. These are all small species. The bantam sunfish is the smallest sunfish species commonly found in south Louisiana. In spite of its name, the banded pigmy sunfish is not in the same family as the other sunfishes and is one of the smallest fishes found in south Louisiana. It is a unique representative of its family (Elassomatidae) in south Louisiana and relatively common in habitats with thick aquatic vegetation. The golden topminnow, the western mosquitofish, the least killifish, and the sailfin molly are common species in small bodies of water and along the shoreline in larger water bodies throughout southeast Louisiana. They are also all commonly found in habitats that have thick aquatic vegetation. Figure 12 shows the location of two sites at which these species were especially common. One site was in Bayou Des Familles, which was sampled in the summer when the vegetation was especially thick. The other site was in an abandoned oil field canal that ran through the marsh. It was also sampled in the summer, and also had thick vegetation along its shores.

In summary, the first two principal components axes identify sites with three different groups of species. PC1 separates mostly euryhaline marine species from freshwater species. PC2 separates freshwater species, those that occupy more open habitats from those that live in the interior of the Preserve in habitats with thick aquatic vegetation.

Figure 9 is a plot of sample sites on the second and third principal components. Group 2 and 3 sites, identified previously, are obvious in this plot, and an additional group can now be seen, those sites with negative scores on PC3 (group 4). The common species at sites in group 4 include *Amia calva* (bowfin), *Dorosoma cepedianum* (gizzard shad), *Erimyzon sucetta* (lake chubsucker), and *Mugil cephalus* (striped mullet). This is an odd mix of species that would not normally be expected to occur together, but the pattern is clear. The geographic distribution of group 4 sites is shown in figure 13. These sites are all in the interior of the Preserve, in the marsh or in smaller canals and bayous. Striped mullet are common at these sites, and are found at the surface feeding on vegetation or on the bottom feeding on detritus. Gizzard shad are also feeders on vegetation and detritus. The bowfin is commonly a resident of backwaters where oxygen availability is often low. The biological basis for the association of lake chubsuckers with these sites is unclear, but is probably related to the presence of a preferred food source.

There were fourteen species included in the principal components analysis that did not show a consistent pattern of co-occurrence with other species. Some of these were common species that were found in a wide range of habitat types in the Preserve. These common and nearly ubiquitous species include *Lucania parva* (rainwater killifish), *Sciaenops ocellatus* (red drum), *Cprinus carpio* (carp), and *Notemigonus crysoleucas* (golden shiner). Other species did not show a consistent pattern of association with other species because they were collected in too few numbers or at too few sites for a consistent pattern of variation to be detected. These uncommon species were *Pomoxis nigromaculatus* (black crappie), *Cyprinodon variegatus* (sheepshead minnow), *Pogonias cromis* (black drum), *Cynoscion nebulosus* (spotted seatrout), *Atractosteus spatula* (alligator gar), *Dormitator maculatus* (fat sleeper), *Dorosoma petenense* (threadfin shad), *Cynoscion arenarius* (sand seatrout), *Gobionellus boleosoma*

(darter goby), and *Archosargus probatocephalus* (sheepshead*)*. Twelve species were collected at only a single locality and were not included in the analysis (see Table 2).

Physical Measures of the Environment

Table 4 summarizes environmental measures at the sample sites. The wide variation in sample water depth reflects the range of habitat types sampled. The sites sampled within the marsh were the most shallow and the levee ponds at the northeastern border of the park were the deepest. Most sites in the interior of the park were 1 to 2 meters in depth. Samples sites along the lakeshore were usually less than 1 meter in maximum depth. Water temperature varied seasonally and did not vary greatly among sample sites within season.

The lowest pH was in the interior of the park, in the Pipeline Canal and the Horseshoe Canal. The highest pH was along the lakeshores and in Bayou Segnette. The lowest concentrations of dissolved oxygen were found in the interior of the Preserve in the spring and summer particularly in the Horseshoe Canal, the Pipeline Canal, Woods Place Canal and Bayou Des Familles. Dissolved oxygen concentration less than 5 mg/l is generally considered stressful for fish. Thirty-two sample sites had dissolved oxygen concentrations less than 5 mg/l. The highest oxygen concentrations were found at sample sites along the lakeshores and in Bayou Segnette in the spring.

Salinity values are calculated from measures of conductivity. So, the two necessarily vary together. Conductivity values less than 1.0 mmohs result in salinity values of 0. Low conductivity water was found in all regions of the park including along the lakeshore. The lowest values were found during the summer months. The highest conductivity was found during the fall at sample sites along the lakeshore and in the Tarpaper Canal.

Oxidation-reduction potential (ORP) is a measure of the water's ability to reduce or oxidize other chemicals. ORP is related to pH and oxygen content of the water. Low pH waters generally have higher ORP. The lowest ORP was found in the interior of the Preserve, in the Pipeline Canal, Kenta Canal, and

Bayou Des Familles. The highest ORP was found in Bayou Segnette, along the lakeshores, and in water bodies adjacent to them.

Water clarity, as measured by Secchi depth, varied greatly but was generally less than 1 meter. There was no pattern to variation in water clarity either geographically or seasonally. Values along the lakeshore varied from 0.3 to 1.3 meters. Values in interior waterways of the Preserve varied from 0.3 meters in Bayou Boeuf to 1.5 meters in Bayou Des Familles. Wind and recent rainfall appeared to be the primary factors determining water clarity.

Variation in Species Distributions among sites and the Physical Environment

The relationship of environmental variables to fish distributions was analyzed by examining the correlation between the principal components axes and the measured environmental variables, water depth, water temperature, pH, dissolved oxygen, conductivity, salinity, oxidation reduction potential, and Secchi depth. However, to interpret correlations between environmental variables and fish community composition, the correlation between the environmental variables must be understood. The correlation between the environmental variables is shown in table 5. Two of the statistically significant correlations are artifacts of the way the variables were measured or calculated. The values for conductivity and salinity are mathematically related and thus highly correlated. The correlation between the Secchi depth measurement of water clarity and water depth is likely due to the maximum Secchi depth occasionally recorded with the disk sitting on the bottom. The remaining statistically significant correlations are interpretable in terms of the habitat in which the measurements were made. Low pH waters tended to have low dissolved oxygen and a high oxidation-reduction potential. These correlations are expected since waters low in dissolved oxygen tend to be high in CO_2 and other acidifying products of decomposition. Acidic waters also tend to have high reducing power. The waters with low pH and low oxygen concentration tended to be clearer as well.

The correlation between the principal components and the environmental variables is shown in Table 6. The first principal component, which separated sites where the fish communities were composed

of marine and salinity tolerant species (group 1) from sites where the fish communities composed of less tolerant species (group 2 and group 3), is most strongly correlated with the oxygen content of the water and pH. Group 1 sites had higher oxygen content and higher pH. The correlations of environmental variables with the second ad third principal components were weaker but still significantly correlated with the oxygen content of the water. Principal component 2 separated group 2 sites, at which the larger sunfish species were common, from group 3 sites, at which small surface-dwelling species were common. Group 2 sites, with sunfish communities, had waters of slightly higher oxygen content than group 3 sites. Principal component 3 separated sites of very low oxygen content from the others. Group 3 sites generally had low oxygen content, and also had some of the more tolerant species of water with low oxygen content.

Discussion

In this survey of the fishes of the Barataria Preserve a total of 57 species were sampled. These species represent 26 different families of fishes. Most of the species sampled were freshwater fishes typical of sluggish warm water habitats of southeastern Louisiana. These freshwater forms were found throughout the waters of the Preserve and in Lake Catouache and Lake Salvador at the Preserve's western border. A substantial portion of the fish fauna was composed of euryhaline species common to the brackish water habitats of the coastal regions of Louisiana. Most of these species were found in, or in waters adjacent to, Lake Catouache, Lake Salvador, and the Bayou Segnette waterway. Although some of the brackish water species were sampled in substantial numbers at several localities, many were represented by one or a few specimens collected at one or two sample sites. These species are most likely sporadic migrants into waters near the Preserve. The euryhaline marine species found in this survey are a small subset of the coastal fishes in Louisiana that regularly move into freshwater. Thus, the total list of fishes that might be found within the Preserve is likely much larger than found in this survey.

In previous surveys of the fishes of the Barataria Preserve a cumulative total of 50 species had been reported. With the species added in this survey a total of 66 fish species have been sampled in waters of, or near, the Barataria Preserve. Eight species were taken in previous surveys that were not taken in this survey: *Alosa chrysochloris* (skipjack herring), *Bagre marinus* (gafftopsail catfish), *Caranx hippos* (jack crevalle), *Carcharhinus leucas* (bull shark), *Leiostomus xanthurus* (spot), *Centrarchus macropterus* (flier), *Ictiobus bubalus* (smallmouth buffalo), and *Lepomis megalotis* (longear sunfish). The first five are euryhaline marine species and likely to have been sporadic migrants to waters near the Preserve. Smallmouth buffalo, and all the other buffalo suckers, generally inhabit large rivers. The specimen(s) reported previously was probably a migrant from the Mississippi River or Atchafalaya River and entered the Preserve through the Intracoastal Waterway. The remaining species may have been year-round inhabitants of the park in the past and have since gone extinct or become very rare in the Preserve. The bayous and canals in the interior of the preserve appear to provide appropriate habitat for the flier. I sampled many sites with the expectation of finding this species. In my experience this species is often

found in darkly stained acidic waters and is seldom found in association with other sunfish. All sample sites with appropriate habitat for this species had other sunfish in abundance. Longear sunfish are commonly found in slow flowing water elsewhere in southeast Louisiana (Schultz 1996). The habitat within the preserve is not ideal for this species and this may have resulted in its current rarity or absence.

Fifteen species were taken in this survey that were not taken in previous surveys: *Ameiurus nebulosus* (brown bullhead), *Aplodinotus grunniens* (freshwater drum), *Citharichthys spilopterus* (bay whiff), *Cynoscion arenarius* (sand seatrout), *Cynoscion nebulosus* (spotted seatrout), *Dormitator maculatus* (fat sleeper), *Gobionellus boleosoma* (darter goby), *Gobionellus oceanicus* (highfin goby), *Gobionellus shufeldti* (freshwater goby), *Gobiosoma bosc* (naked goby), *Labidesthes sicculus* (brook silverside), *Lepomis cyanellus* (green sunfish), *Membras martinica* (rough silverside), *Syngnathus scovelli* (Gulf pipefish), and *Trinectes maculatus* (hogchoker). Some of these were likely sporadic euryhaline migrants from coastal waters. These include *Citharichthys spilopterus, Cynoscion arenarius, Cynoscion nebulosus, Gobionellus oceanicus,* and *Membras martinica* . All prefer saline waters but occasionally migrate into freshwater. In the Preserve they were all sampled in the Lake Salvador, Lake Catouache, or in the Intracoastal Waterway in the fall when salinity readings were 1 to 3 ppt at all the sites where they were sampled. Three of the goby species *Gobionellus boleosoma, Gobionellus shufeldti,* and *Gobiosoma bosc* were common at multiple sites and are probably all year-round residents of waters of the Preserve along the lakeshores. *Dormitator maculatus* is a secretive species, often living in burrows or other cavities, and can be found in freshwater or brackish habitats. It can be sampled at any time of year but is most often found in the fall when it is moving in preparation for spawning. It is likely resident in the Preserve year-round but its secretive habits make it a rarely seen species. *Syngnathus scovelli* (Gulf pipefish), is a highly euryhaline species that establishes permanent populations in freshwater and in coastal waters of the Gulf of Mexico. It was common and is likely a year-round resident of the Preserve. It may have been overlooked in the past surveys because it is usually found in dense vegetation and does not rise to the surface when stunned by an electrical current. *Aplodinotus grunniens* (freshwater drum), is found throughout southeast Louisiana and most commonly found in lakes and rivers. The single

specimen taken in this study was a small adult and was sampled in the Bayou Segnette Waterway near the Intracoastal Waterway. It is likely common in deeper waters near the Preserve. The single specimen of *Trinectes maculatus* (hogchoker), was a small juvenile, less than 2 cm total length. Hogchokers are highly euryhaline and are commonly found in coastal bayous and canals. *Ameiurus nebulosus* (brown bullhead) is a common species in freshwater throughout Louisiana. The single individual taken in this survey was an adult and sampled in the interior of the park. It is likely a rare, but year-round, resident of the Preserve. The remaining two species *Labidesthes sicculus* (brook silverside), and *Lepomis cyanellus* (green sunfish), were represented by single individuals and may have been recent introduction to the Preserve. The brook silverside is most commonly found in flowing waters in southeast Louisiana. It is common in the Mississippi River and its distributaries. It was sampled in an uncharacteristic habitat for this species, in the interior of the park, near the Twin Canals boat launch. It may have been introduced by fishermen as released bait. However, this specimen was taken during December of 2003 several days after the opening of the Davis Pond freshwater diversion project. The Davis Pond project is intended to introduce freshwater into the Barataria Bay estuary from the Mississippi River through a canal that connects the Mississippi River to Lake Catouache. Thus, it is possible that the single brook silverside taken in this survey was introduced to Lake Catouache and then made its way into the Preserve. The single green sunfish was taken at the eastern end of the Millaudon Canal. Green sunfish are not common in southeast Louisiana except in flowing waters. Thus, it is unlikely that this species is a year-round resident of the Preserve. It may have been introduced to the Preserve through the pumping station that drains a subdivision that borders the Preserve or from the Mississippi River through the Davis Pond diversion structure.

Many of the species taken in this survey that had not been reported from the Preserve previously were taken in seine samples. Thus, any future sampling done in the Preserve to monitor for species changes should include seine samples. Seining in the waters of southern Louisiana is difficult and sometimes unpleasant because of the rarity of firm bottom, but is necessary for capturing many demersal

species. Electrofishing is much easier and suited to a wider variety of habitats, but can't be used where the water is overgrown with surface vegetation, or in habitats that are difficult to access by boat.

With the exception of *Cyprinus carpio* (carp), no non-native species were taken in the Preserve. Carp, originally introduced to North America from Europe, have become so common that they are often not considered an exotic species. No fish species considered threatened or endangered were taken in this survey.

The principal components analysis suggests that there are distinct fish communities in the Barataria Preserve. Four different groups were identified by their co-occurrence at sample sites, marine derived euryhaline species, freshwater species that prefer relatively open shorelines, freshwater species that are small and prefer habitats that have thick aquatic vegetation, and a group of larger species that prefer small shallow waterbodies with abundant vegetation. There is a geographic pattern to the occurrence of these four groups. The first is found along the lakeshores on the western border of the Preserve and in waters easily accessible from the lakes. The second group is found in larger canals and bayous in the interior of the Preserve and along the lakeshores. The third and fourth groups are found only in the interior of the Preserve. Barring serious habitat degradation, or change in salinity regime, this pattern of species groups is likely to be stable within the Preserve.

The common fish associations identified by principal components analysis are correlated with environmental variation in the Preserve. The most important correlates are pH, dissolved oxygen, and water clarity. The interior of the Preserve generally had lower pH, lower dissolved oxygen, and higher water clarity than found in or near the lakes. Acidity and clarity of the water was associated with the separation of marine derived species from freshwater species. Among the freshwater species three groups (2, 3, and 4) were associated with habitats with successively lower oxygen concentrations. Conductivity and salinity were not associated with species distributions even though many of the species sampled had likely come to the Preserve recently from higher salinity waters.

Many of the fish taken in this survey are considered gamefish and these fish were found in moderate abundance. Thus, the waters of the Preserve represent an important resource for recreational

fishing. Both euryhaline marine and freshwater gamefish were common. Active recreational fishing does occur within the Preserve, but is mostly restricted to the banks that can be reached on trails, or the waterways in which motorized boats are permitted. The interior of the Preserve, because it is not easily accessed by fishermen, is potentially an important refuge for gamefish.

There are no components of the fish fauna of the Preserve that appear threatened or endangered by the encroachment of development. Most species found in this study are resistant to pollutants that are commonly associated with storm run-off or agricultural pollution. In a small sample of fish taken from the Preserve, Swarzenski et al. (2004) found no organic contaminants, and low concentrations of inorganic contaminants. The contaminants found and their concentrations were typical of other localities in the region. The expansive marshlands, canals, and bayous near the Preserve also represent a source for replenishment of freshwater species that might be impacted by an extreme saltwater event. No special action seems necessary to maintain the fish fauna of the Preserve in the state that it is in now.

The Davis Pond diversion project is a potential source of introduction of species to the Preserve. Currently water flow from the Mississippi River into Lake Catouache is low and intermittent. The potential for introduction of new species and exotics is likely and will be increased if flow rates from the river are increased in the future. The Mississippi River fish fauna is highly diverse but there are no native species of freshwater fish that appear to represent a threat to the current fish community structure in the Preserve. However, non-native fish species have the potential for causing major ecological changes in the Preserve and the larger coastal ecosystem. Three species are of special concern, *Ctenopharyngoden idella* (grass carp), *Aristichthys nobilis* (bighead carp) and *Hypophthalmichthys molitrix* (silver carp). All are introductions from Asia and are common in the Mississippi River watershed. Grass carp are voracious consumers of aquatic vegetation and thus could have a major impact on habitat and cover for many fish species found in the Preserve. The other two species are extremely efficient planktivores and thus could impact many species through competition for plankton. Although many adult fishes eat smaller fishes, the juveniles of most feed on plankton. The planktivorous carp species are becoming common in the Atchafalaya Basin (pers. comm., Mike Walker, Louisiana Department of Wildlife and Fisheries). No

ecological impact has been documented yet, but there is concern about the impact of these species among many ecologists and fisheries biologists.

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Tables

List of Tables:

Table 1. Compilation of fish species collected from the Barataria Preserve in the time period 1981-1999. Modified from Seale (2000) and Swarzenki et al. (2004)

Family	Species	Common name	Habitat preference
Carcharhinidae	*Carcharhinus leucas*	bull shark	euryhaline marine
Dasyatidae	*Dasyatis sabina*	Atlantic stingray	euryhaline marine
Lepisosteidae	*Lepisosteus oculatus*	spotted gar	euryhaline freshwater
	Lepisosteus spatula	alligator gar	euryhaline freshwater
Amiidae	*Amia calva*	bowfin	freshwater
Elopidae	*Elops saurus*	ladyfish	euryhaline marine
Anguillidae	*Anguilla rostrata*	American eel	euryhaline
Engraulidae	*Anchoa mitchilli*	bay anchovy	euryhaline marine
Clupeidae	*Alosa chrysochloris*	skipjack herring	euryhaline freshwater
	Dorosoma cepedianum	gizzard shad	euryhaline freshwater
	Dorosoma petenense	threadfin shad	euryhaline freshwater
	Brevoortia patronus	Gulf menhaden	euryhaline marine
Cyprinidae	*Cyprinus carpio*	carp	freshwater
	Notemigonus crysoleucas	golden shiner	freshwater
Catostomidae	*Erimyzon sucetta*	lake chubsucker	freshwater
	Ictiobus bubalus	smallmouth buffalo	freshwater
Ictaluridae	*Ictalurus furcatus*	blue catfish	freshwater
	Ictalurus punctatus	channel catfish	freshwater
	Ameiurus natalis	yellow bullhead	freshwater
	Pylodictis olivaris	flathead catfish	freshwater
Ariidae	*Bagre marinus*	gafftopsail catfish	euryhaline marine
Mugilidae	*Mugil cephalus*	striped mullet	euryhaline marine
Atherinidae	*Menidia beryllina*	inland silverside	euryhaline freshwater
Belonidae	*Strongylura marina*	Atlantic needlefish	euryhaline marine
Cyprinodontidae	*Cyprinodon variegatus*	sheepshead minnow	euryhaline marine
Fundulidae	*Fundulus chrysotus*	golden topminnow	freshwater
	Fundulus grandis	Gulf killifish	estuarine
	Fundulus pulvereus	bayou topminnow	estuarine
	Lucania parva	rainwater killifish	euryhaline freshwater
Poeciliidae	*Gambusia affinis*	mosquitofish	freshwater
	Heterandria formosa	least killifish	freshwater
	Poecilia latipinna	sailfin molly	euryhaline freshwater
Moronidae	*Morone mississippiensis*	yellow bass	euryhaline freshwater
Centrarchidae	*Centrarchus macropterus*	flier	freshwater
	Lepomis macrochirus	bluegill sunfish	freshwater
	Lepomis megalotis	longear sunfish	freshwater
	Lepomis microlophus	redear sunfish	freshwater
	Lepomis miniatus	redspotted sunfish	freshwater
	Lepomis gulosus	warmouth	freshwater
	Lepomis symmetricus	bantam sunfish	freshwater
	Micropterus salmoides	large mouth bass	freshwater
	Pomoxis nigromaculatus	black crappie	freshwater
Carangidae	*Caranx hippos*	jack crevalle	euryhaline marine
Sparidae	*Archosargus probatocephalus*	sheepshead	euryhaline marine
Sciaenidae	*Leiostomus xanthurus*	spot	euryhaline marine
	Micropogonias undulatus	Atlantic croaker	euryhaline marine
	Sciaenops ocellata	red drum	euryhaline marine
	Pogonias cromis	black drum	euryhaline marine
Elassomatidae	*Elassoma zonatum*	banded pygmy sunfish	freshwater
Bothidae	*Paralichthys lethostigma*	southern flounder	euryhaline freshwater

Table 2. Species taken in or near the Barataria Preserve, the total number of sites where each species was taken, the total number of individuals of each species that was taken, habitat preference of each species and the locality group with which each species was associated as identified by principal components analysis. Species taken in this survey that had not been reported previously in the Preserve are indicated by boldface type.

Family	Species Name	Sites	Total	Habitat	Group
Dasyatidae	*Dasyatis sabina* (Atlantic stingray)	2	2	euryhaline marine	1
Lepisosteidae	*Atractosteus spatula* (alligator gar)	3	3	euryhaline freshwater	
	Lepisosteus oculatus (spotted gar)	43	184	freshwater	2
Amiidae	*Amia calva* (bowfin)	7	7	freshwater	4
Elopidae	*Elops saurus* (ladyfish)	4	21	euryhaline marine	1
Anguillidae	*Anguilla rostrata* (American eel)	4	4	euryhaline	2
Engraulidae	*Anchoa mitchilli* (bay anchovy)	24	1553	euryhaline marine	1
Clupeidae	*Brevoortia patronus* (Gulf menhaden)	14	903	euryhaline marine	1
	Dorosoma cepedianum (gizzard shad)	8	16	euryhaline freshwater	4
	Dorosoma petenense (threadfin shad)	2	33	euryhaline freshwater	
Cyprinidae	*Cyprinus carpio* (carp)	14	24	freshwater	
	Notemigonus crysoleucas (golden shiner)	11	61	freshwater	
Catostomidae	*Erimyzon sucetta* (lake chubsucker)	7	10	freshwater	4
Ictaluridae	*Ameiurus natalis* (yellow bullhead)	1	1	freshwater	
	***Ameiurus nebulosus* (brown bullhead)**	1	1	freshwater	
	Ictalurus furcatus (blue catfish)	6	7	freshwater	1
	Ictalurus punctatus (channel catfish)	16	29	freshwater	1
	Pylodictis olivaris (flathead catfish)	1	1	freshwater	
Mugilidae	*Mugil cephalus* (striped mullet)	33	123	euryhaline marine	4
Atherinidae	***Labidesthes sicculus* (brook silverside)**	1	1	freshwater	
	***Membras martinica* (rough silverside)**	2	8	euryhaline marine	1
	Menidia beryllina (inland silverside)	20	209	euryhaline	2
Belonidae	*Strongylura marina* (Atlantic needlefish)	3	5	euryhaline marine	1
Fundulidae	*Fundulus chrysotus* (golden topminnow)	17	130	freshwater	3
	Fundulus grandis (Gulf killifish)	1	1	estuarine	
	Fundulus pulvereus (bayou killifish)	1	4	euryhaline freshwater	

Poeciliidae	*Gambusia affinis* (western mosquitofish)	19	605	freshwater	3
	Heterandria formosa (least killifish)	21	525	freshwater	3
	Poecilia latipinna (sailfin molly)	9	167	euryhaline freshwater	3
Cyprinodontidae	*Cyprinodon variegatus* (sheepshead minnow)	4	6	euryhaline marine	
	Lucania parva (rainwater killifish)	21	233	euryhaline freshwater	
Syngnathidae	***Syngnathus scovelli* (Gulf pipefish)**	10	35	euryhaline	1
Moronidae	*Morone mississippiensis* (yellow bass)	1	1	euryhaline freshwater	
Centrarchidae	***Lepomis cyanellus* (green sunfish)**	1	1	freshwater	
	Lepomis gulosus (warmouth sunfish)	33	155	freshwater	2
	Lepomis macrochirus (bluegill sunfish)	47	803	freshwater	2
	Lepomis microlophus (redear sunfish)	47	805	freshwater	2
	Lepomis miniatus (spotted sunfish)	44	735	freshwater	2
	Lepomis symmetricus (bantam sunfish)	14	98	freshwater	3
	Micropterus salmoides (large mouth bass)	57	325	freshwater	2
	Pomoxis nigromaculatus (black crappie)	5	5	freshwater	
Sparidae	*Archosargus probatocephalus* (sheepshead)	2	2	euryhaline marine	
Sciaenidae	***Aplodinotus grunniens* (freshwater drum)**	1	1	freshwater	
	***Cynoscion arenarius* (sand seatrout)**	2	22	euryhaline marine	
	***Cynoscion nebulosus* (spotted seatrout)**	3	4	euryhaline marine	
	Micropogonias undulatus (Atlantic croaker)	7	37	euryhaline marine	1
	Pogonias cromis (black drum)	4	5	euryhaline marine	
	Sciaenops ocellatus (red drum)	15	50	euryhaline marine	
Elassomatidae	*Elassoma zonatum* (banded pigmy sunfish)	5	148	freshwater	3
Eleotridae	***Dormitator maculatus* (fat sleeper)**	3	3	euryhaline marine	
Gobiidae	***Gobionellus boleosoma* (darter goby)**	2	3	euryhaline marine	
	***Gobionellus oceanicus* (highfin goby)**	1	1	euryhaline marine	
	***Gobionellus shufeldti* (freshwater goby)**	5	7	euryhaline	1
	***Gobiosoma bosc* (naked goby)**	8	74	euryhaline marine	1
Bothidae	***Citharichthys spilopterus* (bay whiff)**	1	3	euryhaline marine	
	Paralichthys lethostigma (southern flounder)	6	7	euryhaline marine	1
Soleidae	***Trinectes maculatus* (hogchoker)**	1	1	euryhaline marine	

Table 3. The number of species taken by each collecting method and the number of sites where each species was found using that method.

	Method							
	Seine		Electrofishing		Gill Net		Trammel Net	
Species	**Sites**	**Total**	**Sites**	**Total**	**Sites**	**Total**	**Sites**	**Total**
Dasyatis sabina (Atlantic stingray)	2	2						
Atractosteus spatula (alligator gar)			1	1	2	2		
Lepisosteus oculatus (spotted gar)	3	3	33	170	7	11		
Amia calva (bowfin)			7	7				
Elops saurus (ladyfish)	3	19	1	2				
Anguilla rostrata (American eel)			4	4				
Anchoa mitchilli (bay anchovy)	16	1392	8	161				
Brevoortia patronus (Gulf menhaden)	10	613	3	289	1	1		
Dorosoma cepedianum (gizzard shad)	2	3	2	3	4	10		
Dorosoma petenense (threadfin shad)	2	33						
Cyprinus carpio (carp)			2	2	3	3	9	19
Noteuryhaline marineigonus crysoleucas (golden shiner)	4	14	7	47				
Erimyzon sucetta (lake chubsucker)			7	10				
Ameiurus natalis (yellow bullhead)			1	1				
***Ameiurus nebulosus* (brown bullhead)**			1	1				
Ictalurus furcatus (blue catfish)	2	2	1	2	3	3		
Ictalurus punctatus (channel catfish)	9	21	5	6	2	2		
Pylodictis olivaris (flathead catfish)	1	1						
Mugil cephalus (striped mullet)	8	10	23	105	2	8		
***Labidesthes sicculus* (brook silverside)**	1	1						
***Membras martinica* (rough silverside)**	2	8						
Menidia beryllina (inland silverside)	14	193	6	16				
Strongylura marina (Atlantic needlefish)	2	4	1	1				
Fundulus chrysotus (golden topminnow)	6	105	11	27				
Fundulus grandis (Gulf killifish)	1	1						
Fundulus pulvereus (bayou killifish)			1	4				
Gambusia affinis (western mosquitofish)	7	161	11	425				
Heterandria formosa (least killifish)	8	225	12	282				

Poecilia latipinna (sailfin molly)	4	126	4	35				
Cyprinodon variegatus (sheepshead minnow)	1	1	2	3				
Lucania parva (rainwater killifish)	12	185	8	43				
***Syngnathus scovelli* (Gulf pipefish)**	10	35						
Morone mississippiensis (yellow bass)	1	1						
***Lepomis cyanellus* (green sunfish)**			1	1				
Lepomis gulosus (warmouth sunfish)	10	37	23	118				
Lepomis macrochirus (bluegill sunfish)	14	309	33	494				
Lepomis microlophus (redear sunfish)	14	411	33	394				
Lepomis miniatus (spotted sunfish)	14	313	29	418				
Lepomis symmetricus (bantam sunfish)	7	50	6	47				
Micropterus salmoides (large mouth bass)	11	78	35	230	9	15	2	2
Pomoxis nigromaculatus (black crappie)	1	1	3	3	1	1		
Archosargus probatocephalus (sheepshead)					1	1	1	1
***Aplodinotus grunniens* (freshwater drum)**			1	1				
***Cynoscion arenarius* (sand seatrout)**	2	22						
***Cynoscion nebulosus* (spotted seatrout)**	1	2			2	3		
Micropogonias undulatus (Atlantic croaker)	5	35			2	2		
Pogonias cromis (black drum)	2	3			2	2		
Sciaenops ocellatus (red drum)	2	4	2	4	9	40	2	2
Elassoma zonatum (banded pigmy sunfish)	3	139	2	9				
***Dormitator maculatus* (fat sleeper)**	1	1	2	2				
***Gobionellus boleosoma* (darter goby)**	2	3						
***Gobionellus oceanicus* (highfin goby)**	1	1						
***Gobionellus shufeldti* (freshwater goby)**	4	6	1	1				
***Gobiosoma bosc* (naked goby)**	8	74						
***Citharichthys spilopterus* (bay whiff)**	1	3						
Paralichthys lethostigma (southern flounder)	2	2			3	4	1	1
***Trinectes maculatus* (hogchoker)**	1	1						

Table 4. Summary of measures of the physical environment at sampling stations.

	Mean	Standard deviation	minimum	maximum
Water Depth (m)	1.3	0.6	0.2	5.0
Water Temperature (C)	23.0	5.6	12.3	32.0
pH	7.15	0.73	5.95	8.82
Dissolved oxygen (mg/l)	6.59	2.79	0.51	12.85
Conductivity (mmohs)	1.23	1.05	0.26	6.08
Oxidation Reduction Potential	0.34	0.14	0.08	0.77
Salinity (ppt)	0.25	0.46	0.00	2.60
Secchi Depth (m)	0.72	0.35	0.20	1.90

Table 5. Correlations among environmental variables. Statistically significant correlations are indicated by * ($p<0.05$), ** ($p<0.01$), and *** ($p<0.001$).

	water depth	**water temperature**	**pH**	**dissolved oxygen**	**conductivity**	**oxidation reduction potential**	**salinity**
water temperature	0.115						
pH	-0.027	0.179					
dissolved oxygen	-0.014	-0.118	0.725 ***				
conductivity	0.116	0.057	0.039	0.219			
oxidation reduction potential	-0.176	0.036	-0.371 **	-0.259 *	-0.175		
salinity	0.107	0.177	0.089	0.228	0.946 ***	-0.196	
Secchi depth	0.289 *	0.092	-0.359 **	-0.450 ***	-0.139	0.145	-0.121

Table 6. The correlation between the principal components identified in the analysis of fish communities and the environmental variables. Statistically significant correlations are indicated by * ($p<0.05$), ** ($p<0.01$), and *** ($p<0.001$).

	water depth	water temperature	pH	dissolved oxygen	conductivity	oxidation reduction potential	salinity	Secchi depth
PC1	-0.153	0.052	0.566 ***	0.484 ***	-0.016	-0.319 **	0.030	-0.271 *
PC2	0.160	-0.221	0.074	0.253 *	0.228	-0.074	0.159	0.046
PC3	-0.013	-0.088	0.165	0.247 *	-0.140	-0.258 *	-0.138	0.003

Figures

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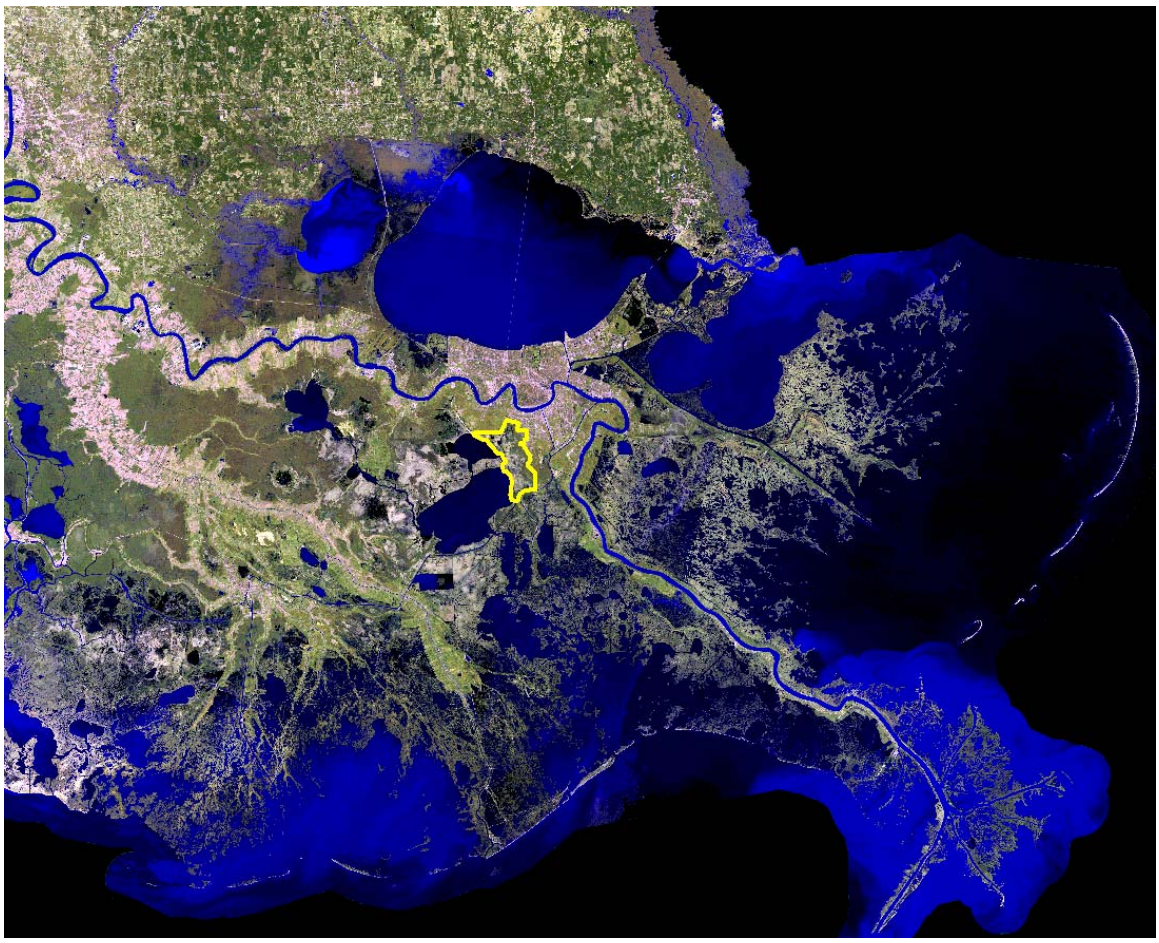

Figure 1. The location of the Barataria Preserve in southeast Louisiana.

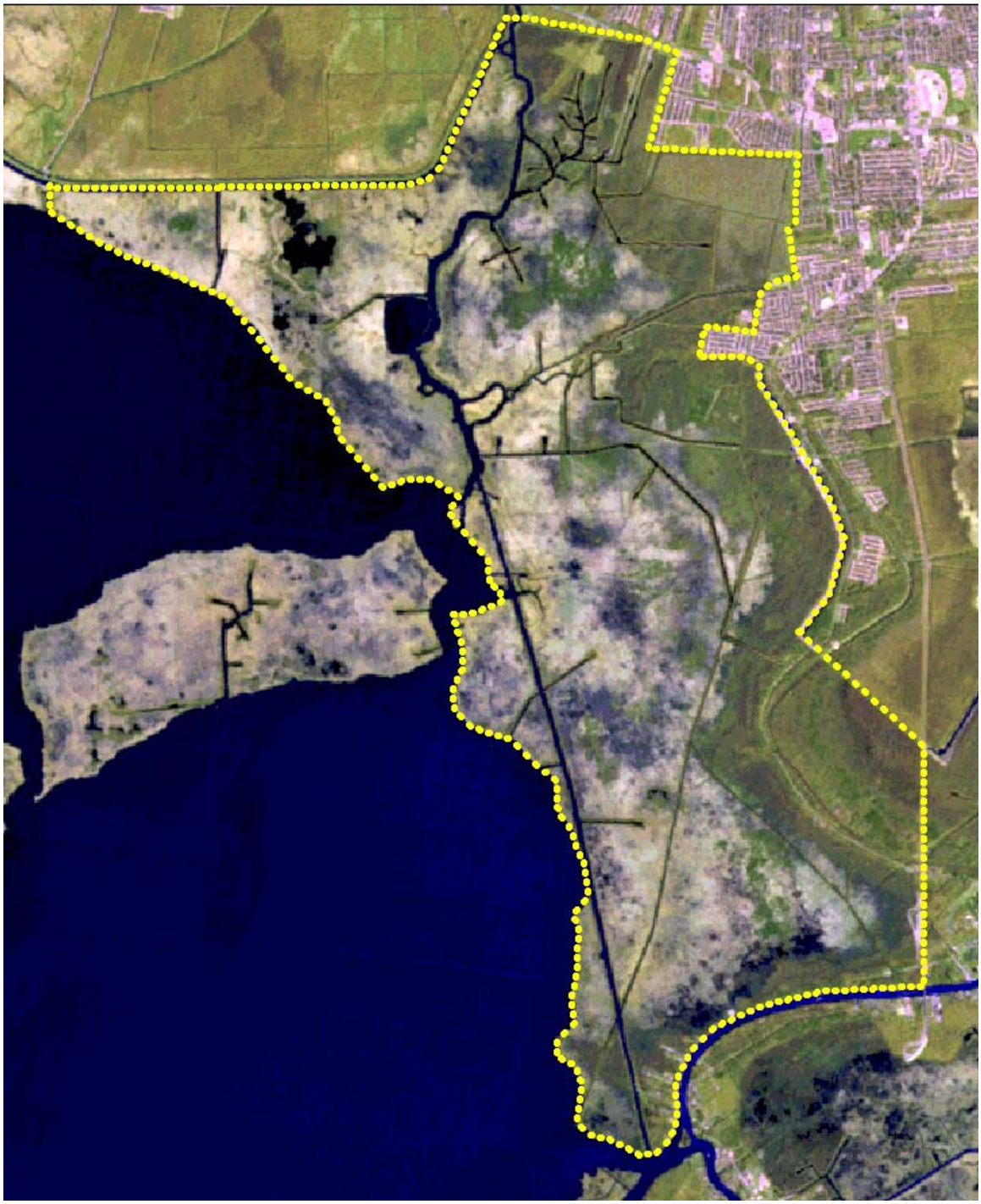

Figure 2. The geographic boundaries of the Barataria Preserve.

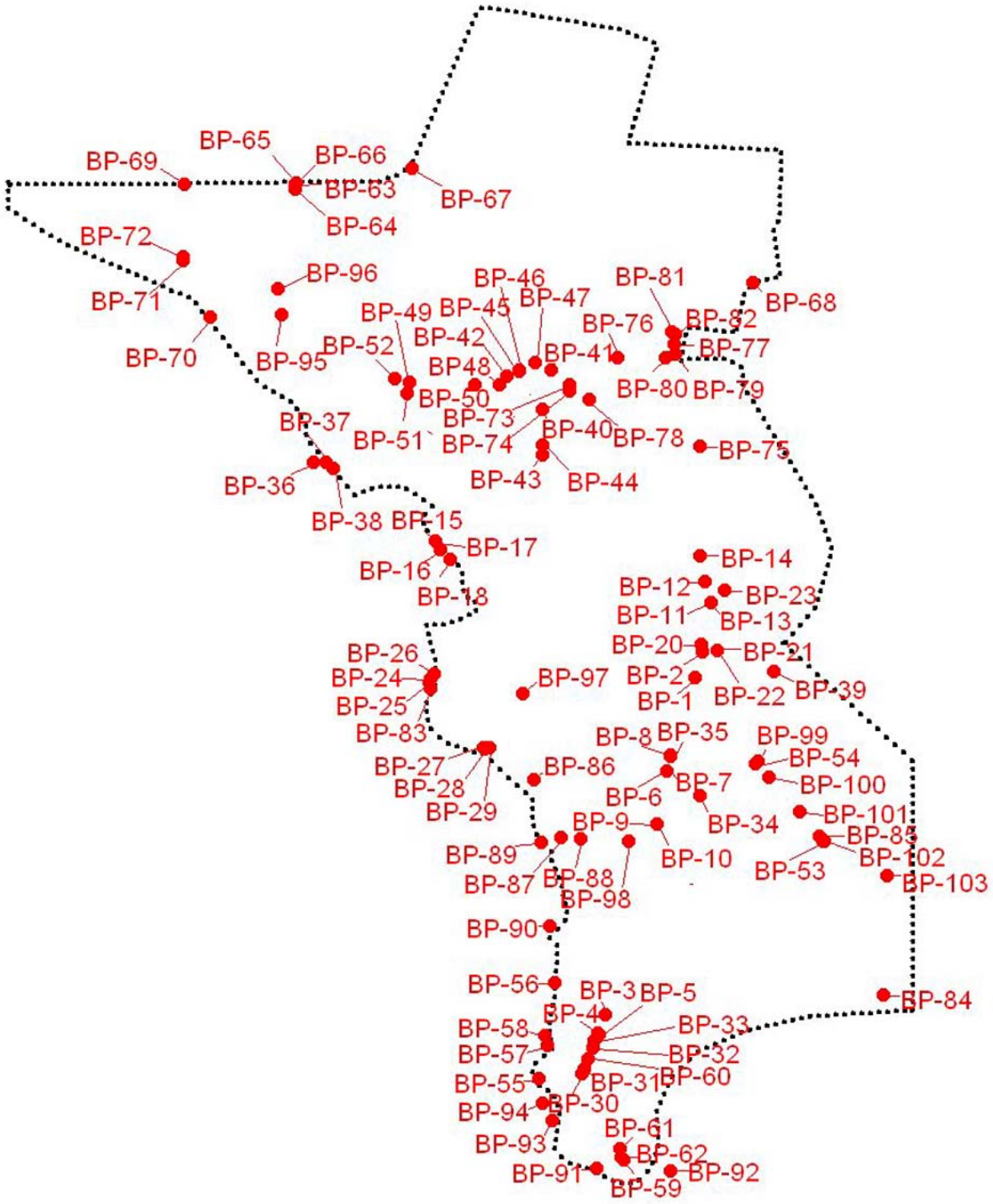

Figure 3. The location of sample sites. See Appendix 1 for a description of each site.

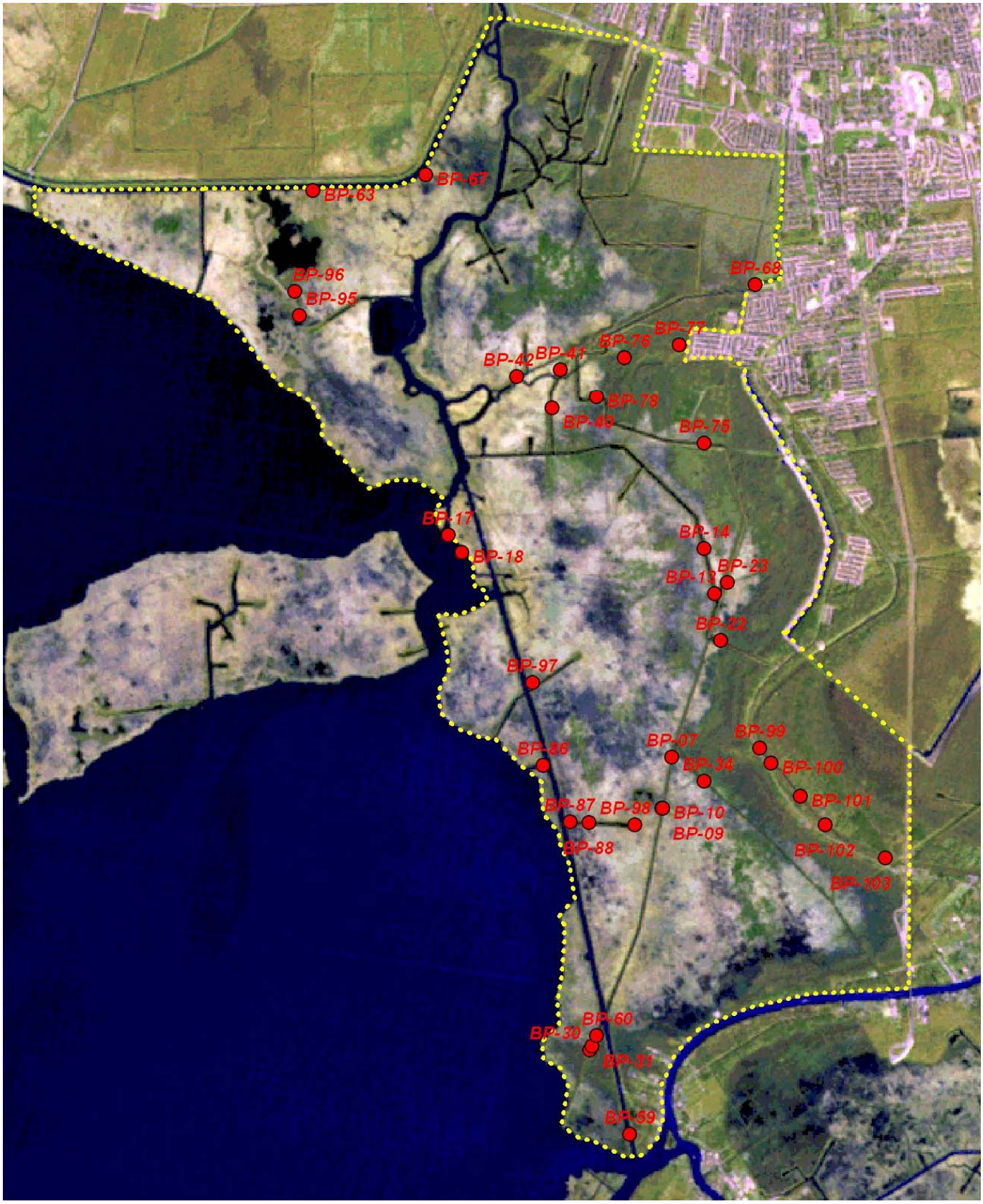

Figure 4. The location of sites sampled by electrofishing.

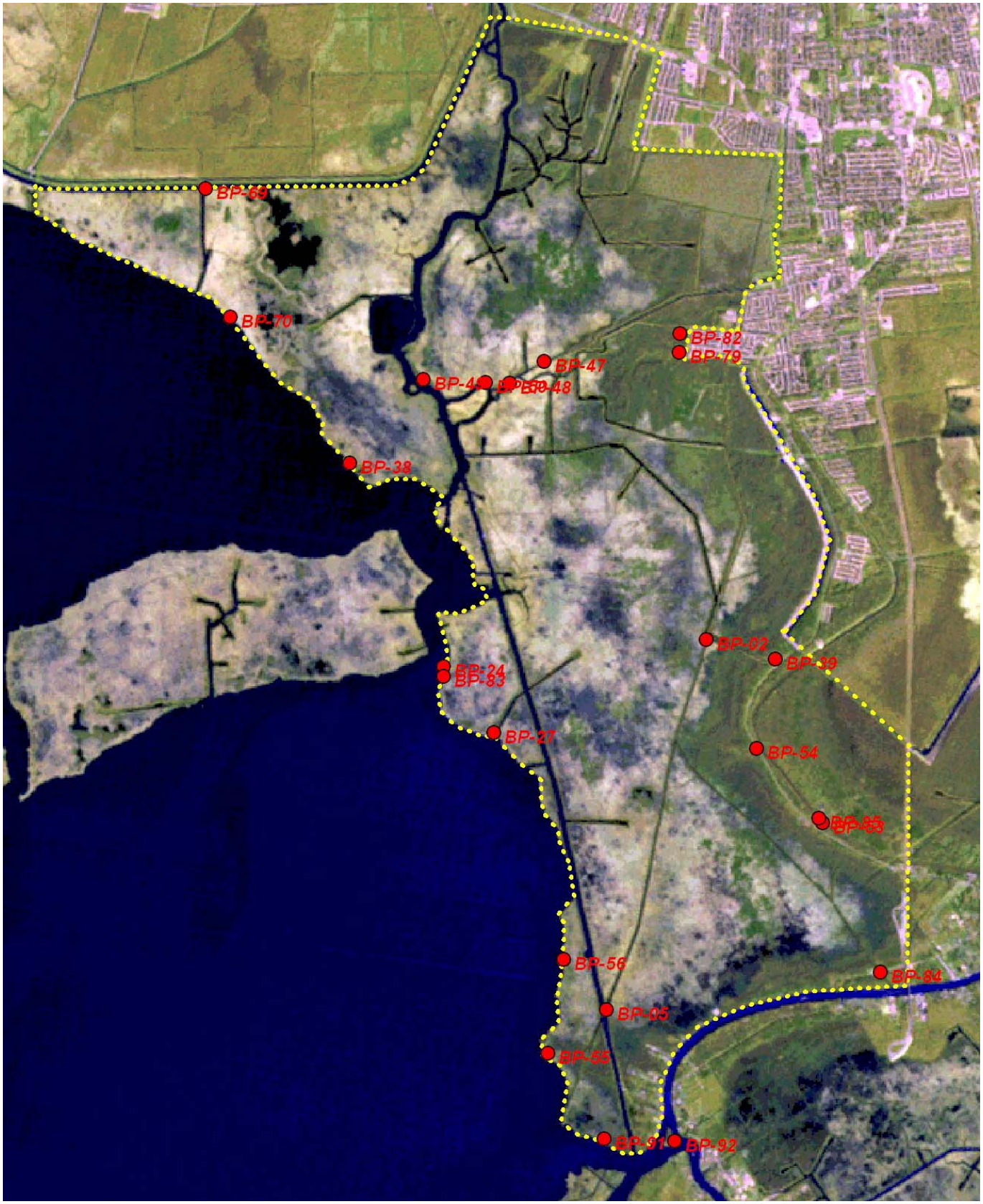

Figure 5. The location of sites sampled by seining.

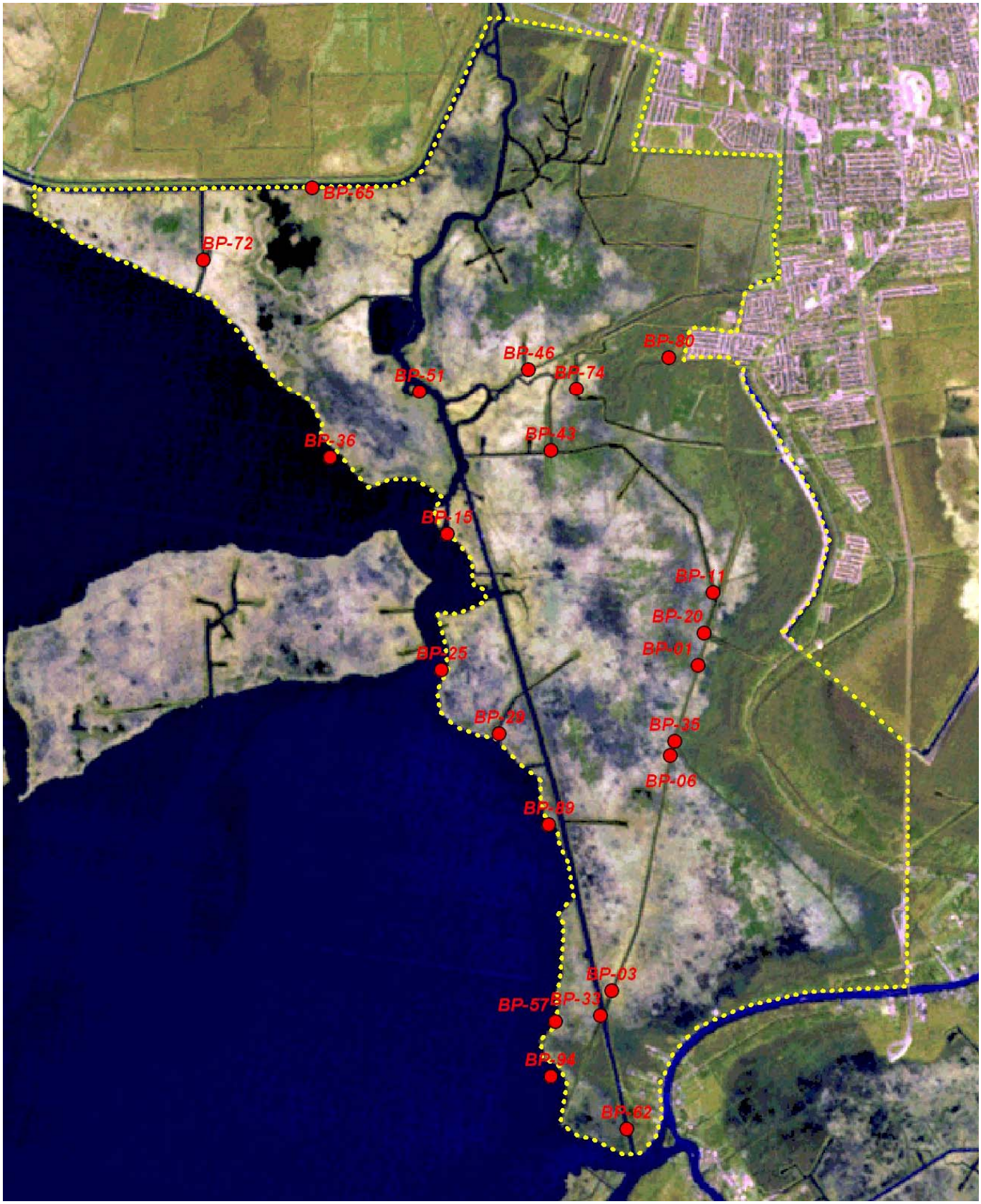

Figure 6. The location of sites sampled with a gillnet.

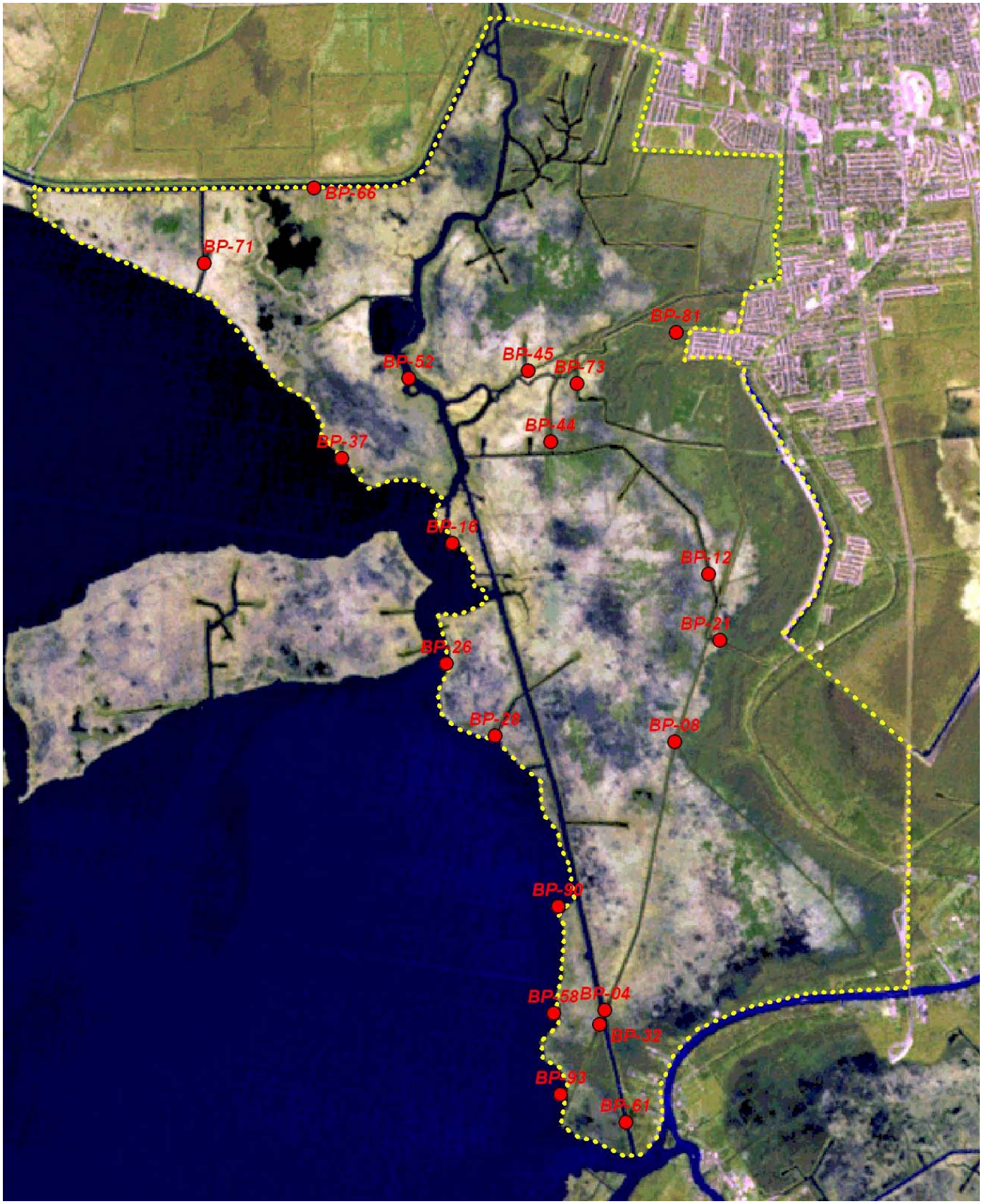

Figure 7. The location of sites sampled with a trammel net.

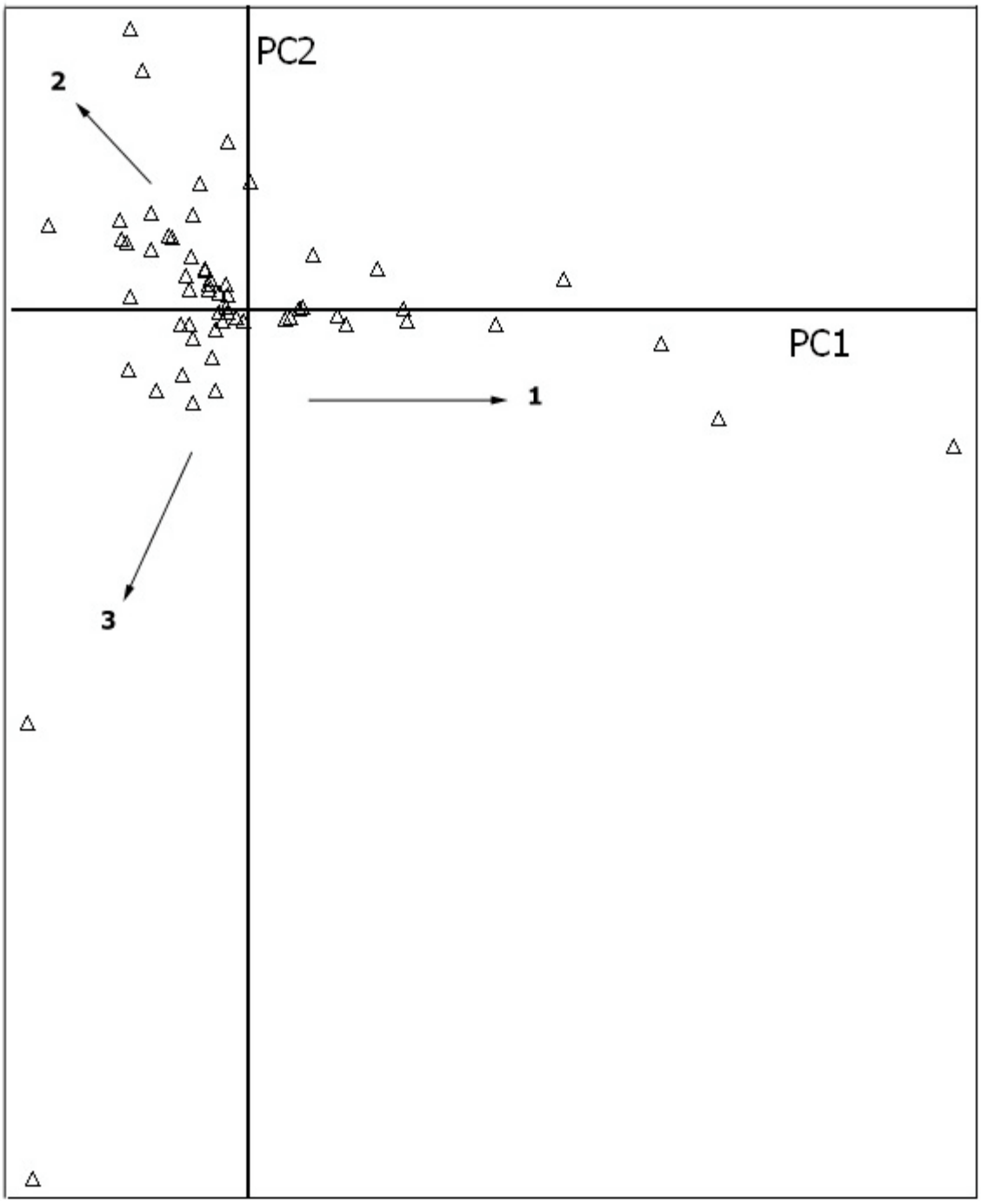

Figure 8. A plot of sample site scores on principal component 1 and principal component 2. Three extremes in community composition are apparent. Group 1 sites have high positive scores on PC1. Groups 2 sites have negative scores on PC1 and positive scores on PC2. Group 3 sites have negative scores on both PC1 and PC2. See figure 10, 11, and 12 for the geographic locations of sites that fall into the three groups.

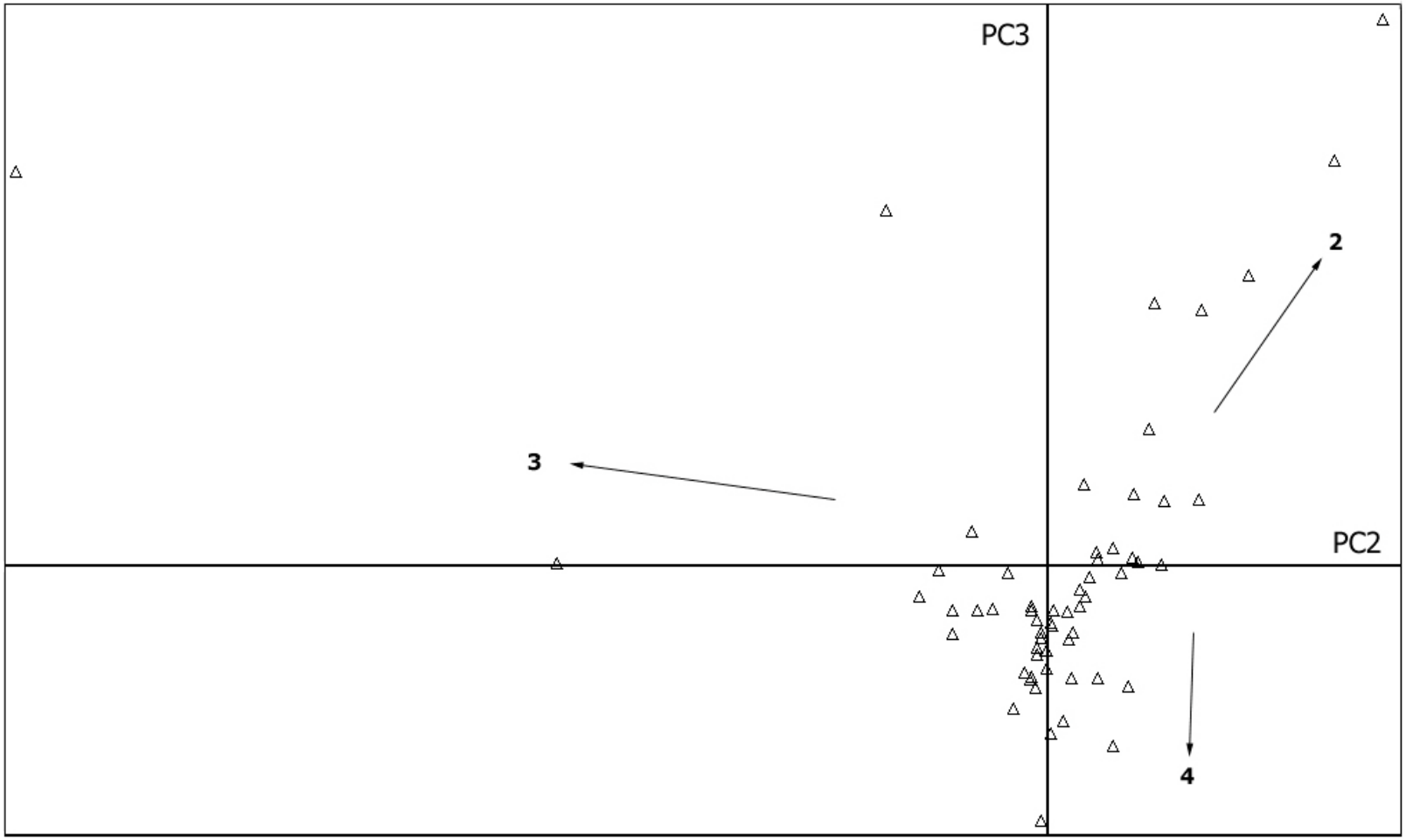

Figure 9. A plot of sample site scores on principal component 2 and principal component 3. Three extremes in community composition are apparent. Group 2 sites have high positive scores on PC2 and PC3. Groups 3 sites have negative scores on PC2 and positive scores on PC3. Group 4 sites have negative scores on PC3. See figure 11, 12, and 13 for the geographic locations of sites that fall into the three groups.

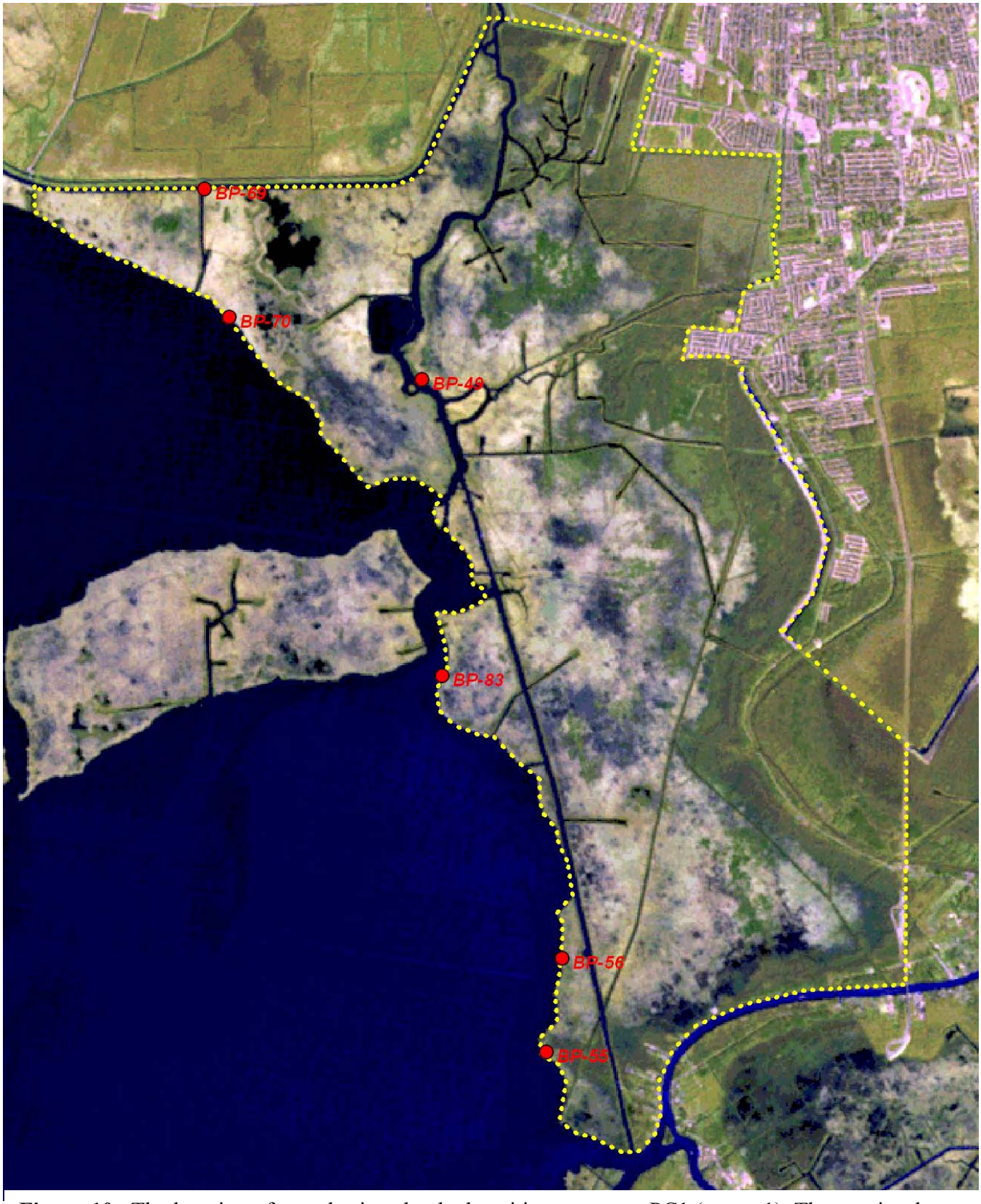

Figure 10. The location of sample sites that had positive scores on PC1 (group 1). The species that were most common at these sites were *Gobiosoma bosc, Gobionellus shufeldti, Micropogonias undulatus, Dasyatis sabina, Syngnathus scovelli, Membras martinica, Ictalurus furcatus, Ictalurus punctatus, Elops saurus, Brevoortia patronus, Anchoa mitchilli, Paralichthys lethostigma* and *Strongylura marina.*

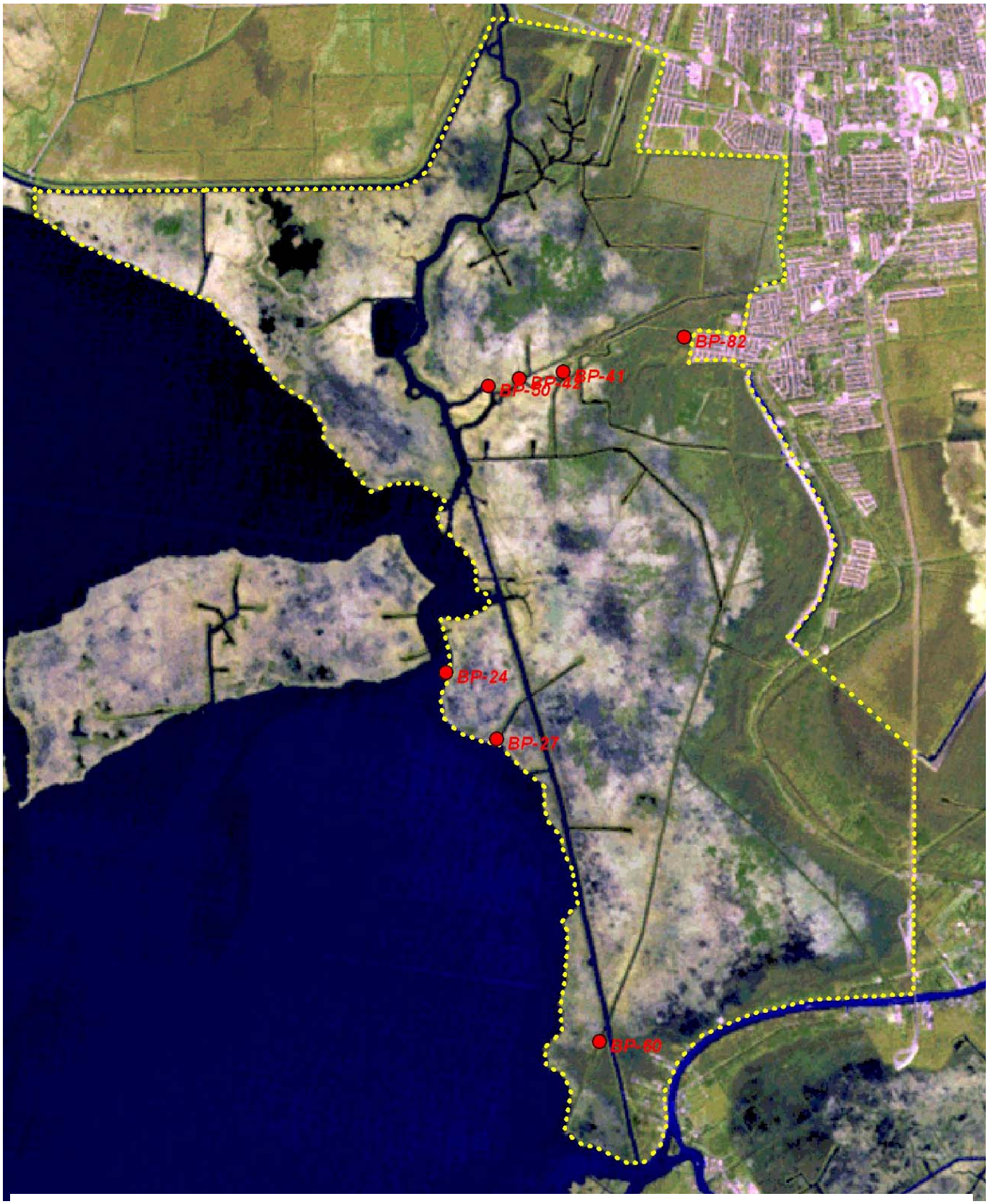

Figure 11. The location of sample sites that had negative scores on PC1 and positive scores on PC2 and PC3 (group 2). The species that were most common at these sites were *Lepomis gulosus, Lepomis macrochirus, Lepomis microlophus, Lepomis miniatus, Lepisosteus oculatus,* and *Micropterus salmoides.*

Figure 12. The location of sites identified by PCA having negative scores on PC1 and PC2 (group 3). The species that were most common at these sites were *Poecilia latipinna, Gambusia affinis, Lepomis symmetricus, Heterandria formosa, Fundulus chrysotus,* and *Elassoma zonatum.*

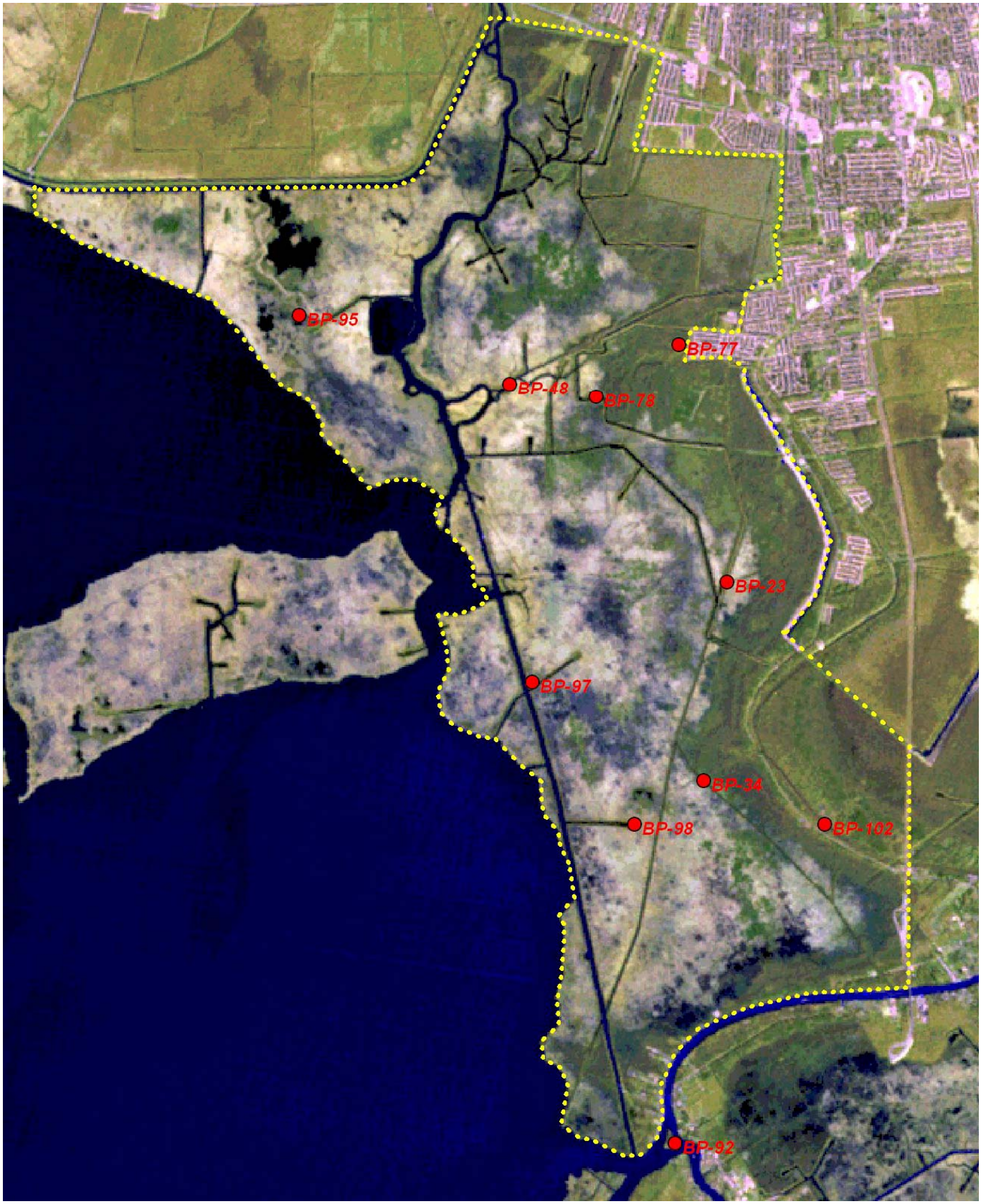

Figure 13. The location of sample sites that had negative scores on PC3 (group 4). The species that were most common at these sites were *Dorosoma cepedianum, Mugil cephalus, Amia calva,* and *Erimyzon sucetta.*

Appendix 1. Description of location of sample sites and date of sampling. Latitude and longitude were recorded in WGS84 coordinates.

Site ID	Site Description	Date	Latitude	Longitude
BP-01	Louisiana - in Jean Lafitte National Park Barataria Preserve - Pipeline Canal	11-Sep-03	29.80516	90.13024
BP-02	Louisiana - in Jean Lafitte National Park Barataria Preserve - Pipeline Canal	11-Sep-03	29.80846	90.12899
BP-03	Barataria Preserve - Pipeline Canal	18-Sep-03	29.76281	90.14443
BP-04	Barataria Preserve - Bayou Segnette at Pipeline Canal	18-Sep-03	29.76046	90.14555
BP-05	Bayou Segnette at Pipeline Canal	18-Sep-03	29.76034	90.14537
BP-06	Barataria Preserve in Pipeline Canal	02-Oct-03	29.79342	90.13472
BP-07	Barataria Preserve in Pipeline Canal	02-Oct-03	29.79342	90.13472
BP-08	Barataria Preserve at mouth of Kenta Canal	02-Oct-03	29.79539	90.13414
BP-09	Barataria Preserve in Pipeline Canal	02-Oct-03	29.78676	90.13637
BP-10	Barataria Preserve - Marsh Pond off Pipeline Canal	02-Oct-03	29.78676	90.13623
BP-11	Barataria Preserve - Tarpaper Canal	09-Oct-03	29.81464	90.12763
BP-12	Barataria Preserve - Tarpaper Canal	09-Oct-03	29.81723	90.12841
BP-13	Barataria Preserve - Tarpaper Canal	09-Oct-03	29.81466	90.12763
BP-14	Barataria Preserve - Tarpaper Canal	09-Oct-03	29.82061	90.12905
BP-15	Barataria Preserve - at waterway between Bayou Bardeaux to Lake Salvador	16-Oct-03	29.82318	90.16742
BP-16	Barataria Preserve - at waterway between Bayou Bardeaux to Lake Salvador	16-Oct-03	29.82210	90.16676
BP-17	Barataria Preserve - at waterway between Bayou Bardeaux to Lake Salvador	16-Oct-03	29.82318	90.16742
BP-18	Barataria Preserve - at waterway between Bayou Bardeaux to Lake Salvador	16-Oct-03	29.82083	90.16537
BP-20	Barataria Preserve at intersection of Pipeline Canal and Tarpaper Canal	16-Oct-03	29.80933	90.12922
BP-21	Barataria Preserve in north canal of Twin Canals	16-Oct-03	29.80849	90.12695
BP-22	Barataria Preserve in marsh off of in into main canal of Twin Canals	16-Oct-03	29.80849	90.12695
BP-23	Barataria Preserve - Ross Canal starting at mouth	16-Oct-03	29.81604	90.12568

BP-24	Barataria Preserve at North end of Lake Salvador	17-Oct-03	29.80580	90.16854
BP-25	Barataria Preserve at North end of Lake Salvador	17-Oct-03	29.80540	90.16880
BP-26	Barataria Preserve at North end of Lake Salvador	17-Oct-03	29.80637	90.16813
BP-27	Barataria Preserve at East shore Lake Salvador	17-Oct-03	29.79700	90.16125
BP-28	Barataria Preserve at East shore Lake Salvador	17-Oct-03	29.79675	90.16108
BP-29	Barataria Preserve at East shore Lake Salvador	17-Oct-03	29.79688	90.16030
BP-30	Barataria Preserve at dead end of pipeline canal	10-Dec-03	29.75540	90.14805
BP-31	Barataria Preserve at dead end of pipeline canal	10-Dec-03	29.75596	90.14778
BP-32	Barataria Preserve, just inside mouth of dead end pipeline canal	10-Dec-03	29.75860	90.14647
BP-33	Barataria Preserve, just inside mouth of dead end pipeline canal	10-Dec-03	29.75960	90.14613
BP-34	Barataria Preserve - Kenta Canal	10-Dec-03	29.79013	90.12996
BP-35	Barataria Preserve - Kenta Canal	10-Dec-03	29.79531	90.13402
BP-36	Barataria Preserve - East shore Lake Cataouche	16-Dec-03	29.83353	90.18473
BP-37	Barataria Preserve - East shore Lake Cataouche	16-Dec-03	29.83355	90.18302
BP-38	Barataria Preserve - East shore Lake Cataouche	16-Dec-03	29.83271	90.18192
BP-39	Barataria Preserve at Twin Canals boat launch	16-Dec-03	29.80570	90.11872
BP-40	Barataria Preserve - Davis Marrero Cut north of Tarpaper Canal	17-Feb-04	29.83949	90.15139
BP-41	Barataria Preserve - in dead end canal off Davis Marrero Cut	17-Feb-04	29.84451	90.14997
BP-42	Barataria Preserve - Bayou Boeuf	17-Feb-04	29.84383	90.15654
BP-43	Barataria Preserve - Davis Marrero Cut north of Tarpaper Canal	17-Feb-04	29.83376	90.15157
BP-44	Barataria Preserve - Davis Marrero Cut north of Tarpaper Canal	17-Feb-04	29.83507	90.15162
BP-45	Barataria Preserve - Millaudon Canal	04-Mar-04	29.84445	90.15475
BP-46	Barataria Preserve - Millaudon Canal	04-Mar-04	29.84456	90.15459
BP-47	Barataria Preserve - Millaudon Canal under powerlines	04-Mar-04	29.84546	90.15231
BP-48	Barataria Preserve - Bayou Boeuf	04-Mar-04	29.84277	90.15757
BP-49	Barataris Preserve - Bayou Segnette	04-Mar-04	29.84348	90.17056
BP-50	Barataria Preserve - Bayou Boeuf	04-Mar-04	29.84289	90.16114
BP-51	Barataria Preserve - Bayou Segnette	04-Mar-04	29.84199	90.17104
BP-52	Barataria Preserve - Bayou Segnette	04-Mar-04	29.84389	90.17273
BP-53	Barataria Preserve - Bayou Des Familles at bridge	11-Mar-04	29.78411	90.11221
BP-54	Barataria Preserve - Bayou Coquille at bridge	11-Mar-04	29.79403	90.12189
BP-55	Barataria Preserve - northeast shore of Lake Salvador	11-Mar-04	29.75481	90.15426
BP-56	Barataria Preserve - northeast shore of Lake Salvador	11-Mar-04	29.76702	90.15164

BP-57	Barataria Preserve - northeast shore of Lake Salvador	11-Mar-04	29.75900	90.15295
BP-58	Barataria Preserve - northeast shore of Lake Salvador	11-Mar-04	29.76030	90.15328
BP-59	Barataria Preserve - Bayou Segnette Waterway just north of Gulf Intracoastal Waterway	16-Apr-04	29.74431	90.14241
BP-60	Barataria Preserve - End of Pipeline Canal and slough to marsh	16-Apr-04	29.75730	90.14705
BP-61	Barataria Preserve - Pipeline Canal north of Gulf Intracoastal Waterway	16-Apr-04	29.74578	90.14288
BP-62	Barataria Preserve - Pipeline Canal north of Gulf Intracoastal Waterway	16-Apr-04	29.74471	90.14269
BP-63	Barataria Preserve - Canal through marsh in northwest part of Park	27-Apr-04	29.86875	90.18647
BP-64	Barataria Preserve - Pools in marsh	27-Apr-04	29.86823	90.18656
BP-65	Barataria Preserve - East-west canal at Northwest side of park	27-Apr-04	29.86904	90.18637
BP-66	Barataria Preserve - East-west canal at Northwest side of park	27-Apr-04	29.86905	90.18625
BP-67	Barataria Preserve - in marsh south of East-west canal at Northwest side of park	27-Apr-04	29.87048	90.16949
BP-68	Barataria Preserve - at east end of Millaudon Canal	27-Apr-04	29.85498	90.12043
BP-69	Barataria Preserve - East-west canal at intersection with North-south Canal at northwest side of park	11-May-04	29.86920	90.20255
BP-70	Barataria Preserve - Lake Catouache	11-May-04	29.85225	90.19928
BP-71	Barataria Preserve - North-south canal at northwest side of park	11-May-04	29.85953	90.20294
BP-72	Barataria Preserve - North-south canal at northwest side of park	11-May-04	29.85994	90.20302
BP-73	Barataria Preserve - Horseshoe Canal	18-May-04	29.84259	90.14743
BP-74	Barataria Preserve - Horseshoe Canal	18-May-04	29.84182	90.14744
BP-75	Barataria Preserve - Horseshoe Canal	18-May-04	29.83433	90.12867
BP-76	Barataria Preserve - Woods Place Canal	18-May-04	29.84593	90.14032
BP-77	Barataria Preserve - unnamed canal and levee pond behind Marrero subdivision	18-May-04	29.84739	90.13205
BP-78	Barataria Preserve - Horseshoe Canal	18-May-04	29.84074	90.14467
BP-79	Barataria Preserve - unnamed canal and levee pond behind Marrero subdivision	01-Jun-04	29.84619	90.13193
BP-80	Barataria Preserve - unnamed canal and levee pond behind Marrero subdivision	01-Jun-04	29.84570	90.13343
BP-81	Barataria Preserve - unnamed canal and levee pond behind Marrero subdivision	01-Jun-04	29.84895	90.13236
BP-82	Barataria Preserve - unnamed canal and levee pond behind Marrero subdivision	01-Jun-04	29.84870	90.13182
BP-83	Barataria Preserve - East shore of Lake Salvador	01-Jun-04	29.80453	90.16860

BP-84	Barataria Preserve - South End of Kenta Canal at bridge	05-Aug-04	29.76437	90.10413
BP-85	Barataria Preserve - Bayou Des Familles at Canoe Launch	05-Aug-04	29.78472	90.11272
BP-86	Barataria Preserve - Canal Between Lake Salvador and Bayou Segnette Waterway - both sides of canal sampled	19-Aug-04	29.79275	90.15406
BP-87	Barataria Preserve - in canal through marsh off Bayou Segnette Waterway	19-Aug-04	29.78529	90.15023
BP-88	Barataria Preserve - in canal through marsh off Bayou Segnette Waterway	19-Aug-04	29.78518	90.14741
BP-89	Barataria Preserve - Lake Salvador - east shore at north end of pilings	19-Aug-04	29.78473	90.15320
BP-90	Barataria Preserve - Lake Salvador - east shore at south end of pilings	19-Aug-04	29.77423	90.15221
BP-91	Barataria Preserve - East shore of Lake Salvador just north of Intracoastal Waterway	01-Oct-04	29.74340	90.14620
BP-92	Barataria Preserve - south side of island on south side of Intracoastal Waterway	01-Oct-04	29.74287	90.13560
BP-93	Barataria Preserve - East shore of Lake Salvador	01-Oct-04	29.74960	90.15251
BP-94	Barataria Preserve - East shore of Lake Salvador	01-Oct-04	29.75183	90.15387
BP-95	Barataria Preserve - in marsh at N. E. end of park	10-Dec-04	29.85244	90.18889
BP-96	Barataria Preserve - in marsh at N. E. end of park	10-Dec-04	29.85560	90.18946
BP-97	Barataria Preserve - North Segnette Cut Canal - off Bayou Segnette Waterway	10-Dec-04	29.80366	90.15531
BP-98	Barataria Preserve - in marsh near South Segnette Cut Canal	10-Dec-04	29.78469	90.14052
BP-99	Barataria Preserve - Bayou Des Familles at Bayou Coquille	01-Mar-05	29.79433	90.12144
BP-100	Barataria Preserve - Bayou Des Familles	01-Mar-05	29.79228	90.11982
BP-101	Barataria Preserve - Bayou Des Familles	01-Mar-05	29.78785	90.11563
BP-102	Barataria Preserve - Bayou Des Familles at bridge	01-Mar-05	29.78410	90.11201
BP-103	Barataria Preserve - Bayou Des Familles at park boundary	01-Mar-05	29.77954	90.10310

Appendix 2. Voucher specimen information, including number in series, sampling method, sample date and time, All voucher specimens are held by the Tulane University Museum of Natural History. Catalog numbers assigned by the museum and by the National Park Service are given. Figure 14 shows the location of sample sites where voucher specimens were taken. Latitude and longitude were recorded in WGS84 coordinates.

Site Name	Site Description	Longitude & Latitude	Species Name	Number	Date	Time	Method	Collecting Crew	Identified by	Tulane University Catalog Number	NPS Catalog Number
BP-05	Bayou Segnette at Pipeline Canal	90.14537 29.76034	Anchoa mitchilli (bay anchovy)	4	9/18/2003	5:30 PM	seine	D. L. Schultz, C. Couch, J. York	D. L. Schultz	198073	JELAB1776
BP-05	Bayou Segnette at Pipeline Canal	90.14537 29.76034	Ictalurus punctatus (channel catfish)	25	9/18/2003	5:30 PM	seine	D. L. Schultz, C. Couch, J. York	D. L. Schultz	198074	JELAB1777
BP-14	Barataria Preserve - Tarpaper Canal	90.12905 29.82061	Lepomis gulosus (warmouth sunfish)	14	10/9/2003	5:15 PM	electrofish	D. L. Schultz, C. Couch, J. York	D. L. Schultz	198075	JELAB1778
BP-24	Barataria Preserve at North end of Lake Salvador	90.16854 29.8058	Menidia beryllina (inland silverside)	5	10/17/2003	9:00 AM	seine	D. L. Schultz, C. Couch, J. York	D. L. Schultz	198076	JELAB1779
BP-24	Barataria Preserve at North end of Lake Salvador	90.16854 29.8058	Lucania parva (rainwater killifish)	82	10/17/2003	9:00 AM	seine	D. L. Schultz, C. Couch, J. York	D. L. Schultz	198077	JELAB1780
BP-24	Barataria Preserve at North end of Lake Salvador	90.16854 29.8058	Syngnathus scovelli (Gulf pipefish)	4	10/17/2003	9:00 AM	seine	D. L. Schultz, C. Couch, J. York	D. L. Schultz	198078	JELAB1781
BP-24	Barataria Preserve at North end of Lake Salvador	90.16854 29.8058	Micropterus salmoides (largemouth bass)	45	10/17/2003	9:00 AM	seine	D. L. Schultz, C. Couch, J. York	D. L. Schultz	198079	JELAB1782
BP-24	Barataria Preserve at North end of Lake Salvador	90.16854 29.8058	Lepomis microlophus (redear sunfish)	16	10/17/2003	9:00 AM	seine	D. L. Schultz, C. Couch, J. York	D. L. Schultz	198080	JELAB1783
BP-24	Barataria Preserve at North end of Lake Salvador	90.16854 29.8058	Lepomis macrochirus (bluegill sunfish)	60	10/17/2003	9:00 AM	seine	D. L. Schultz, C. Couch, J. York	D. L. Schultz	198081	JELAB1784
BP-25	Barataria Preserve at North end of Lake Salvador	90.1688 29.8054	Pogonias cromis (black drum)	1	10/17/2003	8:30 AM	gillnet	D. L. Schultz, C. Couch, J. York	D. L. Schultz	198082	JELAB1785
BP-25	Barataria Preserve at North end of Lake Salvador	90.1688 29.8054	Archosargus probatocephalus (sheepshead)	1	10/17/2003	8:30 AM	gillnet	D. L. Schultz, C. Couch, J. York	D. L. Schultz	198083	JELAB1786
BP-27	Barataria Preserve at East shore Lake Salvador	90.16125 29.797	Notemigonus crysoleucas (golden shiner)	9	10/17/2003	12:00 PM	seine	D. L. Schultz, C. Couch, J. York	D. L. Schultz	198084	JELAB1787
BP-31	Barataria Preserve at dead end of pipeline canal	90.14778 29.75596	Dormitator maculatus (fat sleeper)	1	12/10/2003	11:20 AM	electrofish	D. L. Schultz, C. Couch, J. York	D. L. Schultz	198085	JELAB1788

BP-34	Barataria Preserve - Kenta Canal	90.12996 29.79013	Dorosoma cepedianum (gizzard shad)	2	12/10/2003	2:45 PM	electrofish	D. L. Schultz, C. Couch, J. York	D. L. Schultz	198086 JELAB1789
BP-34	Barataria Preserve - Kenta Canal	90.12996 29.79013	Erimyzon sucetta (lake chubsucker)	1	12/10/2003	2:45 PM	electrofish	D. L. Schultz, C. Couch, J. York	D. L. Schultz	198087 JELAB1790
BP-34	Barataria Preserve - Kenta Canal	90.12996 29.79013	Dormitator maculatus (fat sleeper)	2	12/10/2003	2:45 PM	electrofish	D. L. Schultz, C. Couch, J. York	D. L. Schultz	198088 JELAB1791
BP-38	Barataria Preserve - East shore Lake Cataouche	90.18192 29.83271	Mugil cephalus (striped mullet)	11	12/16/2003	11:00 AM	seine	D. L. Schultz, C. Couch, J. York	D. L. Schultz	198089 JELAB1792
BP-38	Barataria Preserve - East shore Lake Cataouche	90.18192 29.83271	Morone mississippiensis (yellow bass)	1	12/16/2003	11:00 AM	seine	D. L. Schultz, C. Couch, J. York	D. L. Schultz	198090 JELAB1793
BP-38	Barataria Preserve - East shore Lake Cataouche	90.18192 29.83271	Gobiosoma bosc (naked goby)	2	12/16/2003	11:00 AM	seine	D. L. Schultz, C. Couch, J. York	D. L. Schultz	198091 JELAB1794
BP-39	Barataria Preserve at Twin Canals boat launch	90.11872 29.8057	Gambusia affinis (western mosquitofish)	1	12/16/2003	1:30 PM	seine	D. L. Schultz, C. Couch, J. York	D. L. Schultz	198092 JELAB1795
BP-39	Barataria Preserve at Twin Canals boat launch	90.11872 29.8057	Labidesthes sicculus (brook silverside)	6	12/16/2003	1:30 PM	seine	D. L. Schultz, C. Couch, J. York	D. L. Schultz	198093 JELAB1796
BP-42	Barataria Preserve - Bayou Boeuf	90.15654 29.84383	Anguilla rostrata (American eel)	2	2/17/2004	4:00 PM	electrofish	D. L. Schultz, C. Couch, C. Troxler	D. L. Schultz	198094 JELAB1797
BP-42	Barataria Preserve - Bayou Boeuf	90.15654 29.84383	Fundulus pulvereus (bayou killifish)	4	2/17/2004	4:00 PM	electrofish	D. L. Schultz, C. Couch, C. Troxler	D. L. Schultz	198095 JELAB1798
BP-42	Barataria Preserve - Bayou Boeuf	90.15654 29.84383	Cyprinodon variegatus (sheepshead minnow)	1	2/17/2004	4:00 PM	electrofish	D. L. Schultz, C. Couch, C. Troxler	D. L. Schultz	198096 JELAB1799
BP-47	Barataria Preserve - Millaudon Canal under powerlines	90.15231 29.84546	Trinectes maculatus (hogchoker)	1	3/4/2004	9:45 AM	seine	D. L. Schultz, C. Couch, C. Troxler	D. L. Schultz	198097 JELAB1800
BP-48	Barataria Preserve - Bayou Boeuf	90.15757 29.84277	Dorosoma petenense (threadfin shad)	32	3/4/2004	11:00 AM	seine	D. L. Schultz, C. Couch, C. Troxler	D. L. Schultz	198098 JELAB1801
BP-48	Barataria Preserve - Bayou Boeuf	90.15757 29.84277	Gobionellus boleosoma (darter goby)	2	3/4/2004	11:00 AM	seine	D. L. Schultz, C. Couch, C. Troxler	D. L. Schultz	198099 JELAB1802
BP-49	Barataris Preserve - Bayou Segnette	90.17056 29.84348	Brevoortia patronus (Gulf menhaden)	18	3/4/2004	1:30 PM	seine	D. L. Schultz, C. Couch, C. Troxler	D. L. Schultz	198100 JELAB1803
BP-49	Barataris Preserve - Bayou Segnette	90.17056 29.84348	Gobionellus shufeldti (freshwater goby)	3	3/4/2004	1:30 PM	seine	D. L. Schultz, C. Couch, C. Troxler	D. L. Schultz	198101 JELAB1804

BP-49	Barataris Preserve - Bayou Segnette	90.17056 29.84348	Syngnathus scovelli (Gulf pipefish)	7	3/4/2004	1:30 PM	seine	D. L. Schultz, C. Couch, C. Troxler	D. L. Schultz	198102 JELAB1805
BP-50	Barataria Preserve - Bayou Boeuf	90.16114 29.84289	Lucania parva (rainwater killifish)	112	3/4/2004	3:00 PM	seine	D. L. Schultz, C. Couch, C. Troxler	D. L. Schultz	198103 JELAB1806
BP-53	Barataria Preserve - Bayou Des Familles at bridge	90.11221 29.78411	Fundulus chrysotus (golden topminnow)	19	3/11/2004	9:45 AM	seine	D. L. Schultz, C. Couch, C. Troxler	D. L. Schultz	198104 JELAB1807
BP-53	Barataria Preserve - Bayou Des Familles at bridge	90.11221 29.78411	Lepomis symmetricus (bantam sunfish)	7	3/11/2004	9:45 AM	seine	D. L. Schultz, C. Couch, C. Troxler	D. L. Schultz	198105 JELAB1808
BP-53	Barataria Preserve - Bayou Des Familles at bridge	90.11221 29.78411	Elassoma zonatum (banded pigmy sunfish)	12	3/11/2004	9:45 AM	seine	D. L. Schultz, C. Couch, C. Troxler	D. L. Schultz	198106 JELAB1809
BP-54	Barataria Preserve - Bayou Coquille at bridge	90.12189 29.79403	Gambusia affinis (western mosquitofish)	47	3/11/2004	11:00 AM	seine	D. L. Schultz, C. Couch, C. Troxler	D. L. Schultz	198107 JELAB1810
BP-55	Barataria Preserve - northeast shore of Lake Salvador	90.15426 29.75481	Micropogonias undulatus (Atlantic croaker)	19	3/11/2004	2:00 PM	seine	D. L. Schultz, C. Couch, C. Troxler	D. L. Schultz	198108 JELAB1811
BP-55	Barataria Preserve - northeast shore of Lake Salvador	90.15426 29.75481	Poecilia latipinna (sailfin molly)	12	3/11/2004	2:00 PM	seine	D. L. Schultz, C. Couch, C. Troxler	D. L. Schultz	198109 JELAB1812
BP-56	Barataria Preserve - northeast shore of Lake Salvador	90.15164 29.76702	Strongylura marina (Atlantic needlefish)	5	3/11/2004	3:30 PM	seine	D. L. Schultz, C. Couch, C. Troxler	D. L. Schultz	198110 JELAB1813
BP-56	Barataria Preserve - northeast shore of Lake Salvador	90.15164 29.76702	Gobiosoma bosc (naked goby)	13	3/11/2004	3:30 PM	seine	D. L. Schultz, C. Couch, C. Troxler	D. L. Schultz	198111 JELAB1814
BP-56	Barataria Preserve - northeast shore of Lake Salvador	90.15164 29.76702	Membras martinica (rough silverside)	3	3/11/2004	3:30 PM	seine	D. L. Schultz, C. Couch, C. Troxler	D. L. Schultz	198112 JELAB1815
BP-59	Barataria Preserve - Bayou Segnette Waterway just north of Gulf Intracoastal Waterway	90.14241 29.74431	Aplodinotus grunniens (freshwater drum)	1	4/16/2004	12:30 PM	electrofish	D. L. Schultz, C. Couch, C. Troxler	D. L. Schultz	198113 JELAB1816
BP-63	Barataria Preserve - Canal through marsh in northwest part of Park	90.18647 29.86875	Elops saurus (ladyfish)	2	4/27/2004	1:00 PM	electrofish	D. L. Schultz, C. Couch, C. Troxler	D. L. Schultz	198114 JELAB1817
BP-64	Barataria Preserve - Pools in marsh	90.18656 29.86823	Lepomis miniatus (spotted sunfish)	4	4/27/2004	2:00 PM	dipnet	D. L. Schultz, C. Couch, C. Troxler	D. L. Schultz	198115 JELAB1818
BP-64	Barataria Preserve - Pools in marsh	90.18656 29.86823	Heterandria formosa (least killifish)	18	4/27/2004	2:00 PM	dipnet	D. L. Schultz, C. Couch, C. Troxler	D. L. Schultz	198116 JELAB1819
BP-68	Barataria Preserve - at east end of Millaudon Canal	90.12043 29.85498	Lepomis cyanellus (green sunfish)	1	4/27/2004	6:00 PM	electrofish	D. L. Schultz, C. Couch, C. Troxler	D. L. Schultz	198117 JELAB1820

BP-69	Barataria Preserve - East-west canal at intersection with North-south Canal at northwest side of park	90.20255 29.8692	Elops saurus (ladyfish)	1	5/11/2004	10:30 PM	seine	D. L. Schultz, C. Couch, C. Troxler	D. L. Schultz	198118 JELAB1821
BP-69	Barataria Preserve - East-west canal at intersection with North-south Canal at northwest side of park	90.20255 29.8692	Ictalurus furcatus (blue catfish)	3	5/11/2004	10:30 PM	seine	D. L. Schultz, C. Couch, C. Troxler	D. L. Schultz	198119 JELAB1822
BP-70	Barataria Preserve - Lake Catouache	90.19928 29.85225	Elops saurus (ladyfish)	3	5/11/2004	12:00 PM	seine	D. L. Schultz, C. Couch, C. Troxler	D. L. Schultz	198120 JELAB1823
BP-70	Barataria Preserve - Lake Catouache	90.19928 29.85225	Fundulus grandis (Gulf killifish)	1	5/11/2004	12:00 PM	seine	D. L. Schultz, C. Couch, C. Troxler	D. L. Schultz	198121 JELAB1824
BP-70	Barataria Preserve - Lake Catouache	90.19928 29.85225	Micropogonias undulatus (Atlantic croaker)	2	5/11/2004	12:00 PM	seine	D. L. Schultz, C. Couch, C. Troxler	D. L. Schultz	198122 JELAB1825
BP-76	Barataria Preserve - Woods Place Canal	90.14032 29.84593	Ameiurus natalis (yellow bullhead)	1	5/18/2004	12:30 PM	electrofish	D. L. Schultz, C. Troxler, J. York	D. L. Schultz	198123 JELAB1826
BP-83	Barataria Preserve - East shore of Lake Salvador	90.1686 29.80453	Pylodictis olivaris (flathead catfish)	1	6/1/2004	2:30 PM	seine	D. L. Schultz, C. Troxler, D. D. Schultz	D. L. Schultz	198124 JELAB1827
BP-86	Barataria Preserve - Canal Between Lake Salvador and Bayou Segnette Waterway - both sides of canal sampled	90.15406 29.79275	Lepisosteus oculatus (spotted gar)	4	8/19/2004	11:30 AM	electrofish	D. L. Schultz, C. Troxler, J. York	D. L. Schultz	198125 JELAB1828
BP-87	Barataria Preserve - in canal through marsh off Bayou Segnette Waterway	90.15023 29.78529	Ameiurus nebulosus (brown bullhead)	1	8/19/2004	12:30 PM	electrofish	D. L. Schultz, C. Troxler, J. York	D. L. Schultz	198126 JELAB1829
BP-92	Barataria Preserve - south side of island on south side of Intracoastal Waterway	90.1356 29.74287	Cynoscion nebulosus (spotted seatrout)	18	10/1/2004	2:30 PM	seine	D. L. Schultz, C. Troxler	D. L. Schultz	198127 JELAB1830
BP-92	Barataria Preserve - south side of island on south side of Intracoastal Waterway	90.1356 29.74287	Gobionellus oceanicus (highfin goby)	3	10/1/2004	2:30 PM	seine	D. L. Schultz, C. Troxler	D. L. Schultz	198128 JELAB1831
BP-92	Barataria Preserve - south side of island on south side of Intracoastal Waterway	90.1356 29.74287	Citharichthys spilopterus (bay whiff)	2	10/1/2004	2:30 PM	seine	D. L. Schultz, C. Troxler	D. L. Schultz	198129 JELAB1832
BP-92	Barataria Preserve - south side of island on south side of Intracoastal Waterway	90.1356 29.74287	Cynoscion arenarius (sand seatrout)	1	10/1/2004	2:30 PM	seine	D. L. Schultz, C. Troxler	D. L. Schultz	198130 JELAB1833
BP-95	Barataria Preserve - in marsh at N. E. end of park	90.18889 29.85244	Amia calva (bowfin)	1	12/10/2004	10:30 AM	electrofish	D. L. Schultz, C. Troxler, N. Walters	D. L. Schultz	198131 JELAB1834

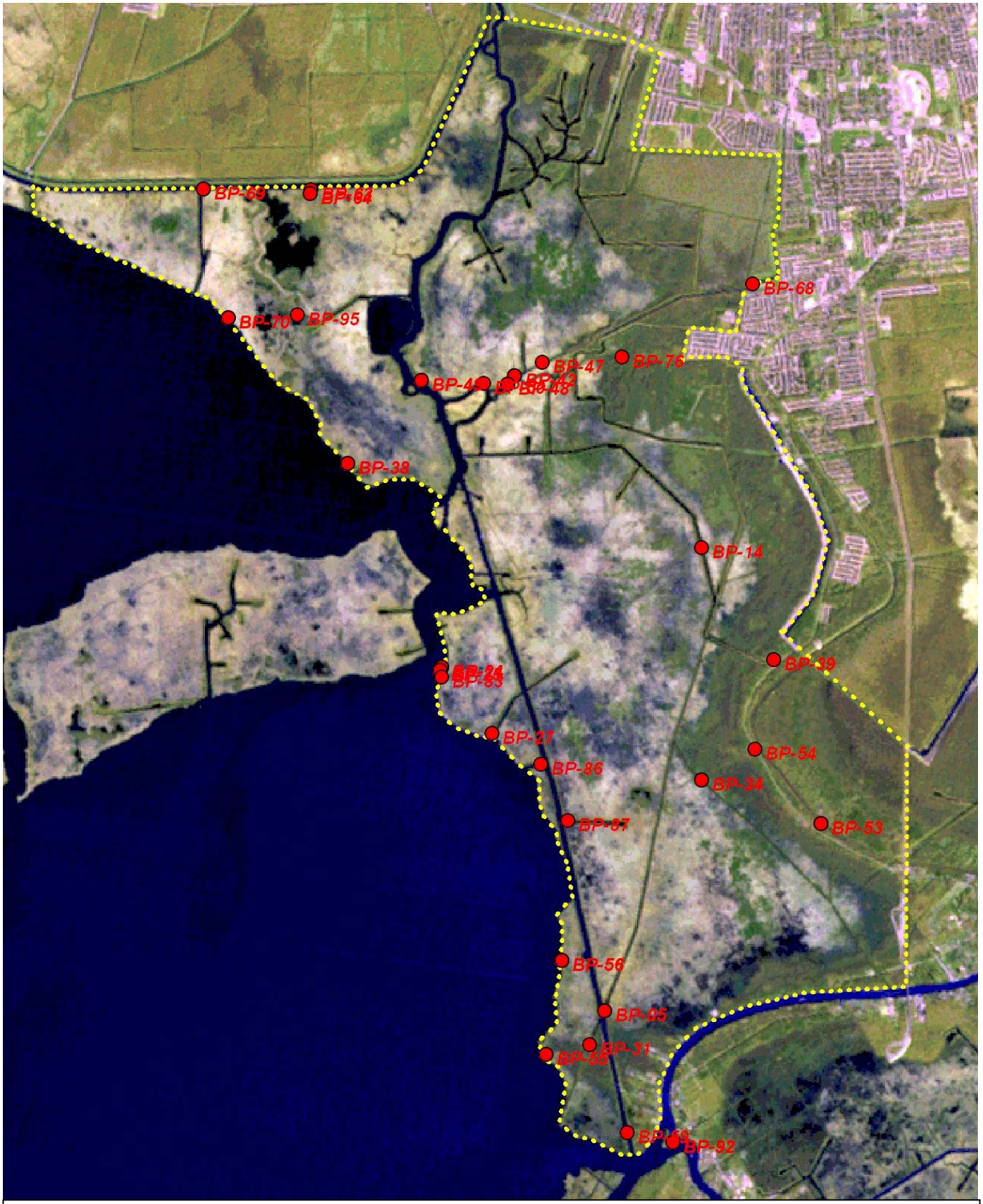

Figure 14. Location of sample sites where voucher specimens were taken.